# Chapter 5
# IMPLEMENTATION STRATEGIES AND BASIS FOR RECOMMENDATIONS

## INTRODUCTION

This chapter identifies and provides key information about the projects and actions that will be undertaken to implement the *Lower East Coast Regional Water Supply Plan* (LEC Plan). Specific recommendations are presented in **Chapter 6**. The first section of Chapter 5 provides an overview of regional water supply plan implementation strategies. It also provides definitions of water resource development and water supply development projects. The remaining two sections of this chapter present and discuss the water resource development projects and water supply development options proposed under this plan.

## REGIONAL WATER SUPPLY PLAN IMPLEMENTATION STRATEGIES

### Regional Water Supply Plan Implementation Assurances

#### Background

During the next 20 years, the South Florida Water Management District (District, SFWMD), the State of Florida, and consumptive users will be partners in implementing regional water supply plans per a directive of Section 373.0361, F.S. The regional water supply plans provide a guide map for meeting consumptive user demands and natural system demands projected for 2020. Economic, technical and political uncertainties are associated with implementing water resource development projects of the complexity and scope recommended in the regional water supply plans. These uncertainties will be particularly evident during the interim period when the various elements will be implemented and become operational. Reasonable certainty is needed for the protection of existing legal users and the water resources during the interim period.

Water resource development projects, operational changes, consumptive use permitting, and rulemaking associated with the regional water supply plans are proposed to occur in phases. The increasing demands of consumptive users and the environment must, to the extent practicable, correspond with the timing of increased water availability. Where shifts from existing sources of water are required for environmental enhancement, it is crucial that replacement sources are available when such shifts occur. Also, resources must be protected from harm, significant harm, and serious harm.

Existing Florida law provides the framework and includes several tools to accomplish these goals. These tools include water reservations, consumptive use permits, Minimum Flows and Levels (MFL) recovery strategies, and water shortage declarations.

A composite schedule for implementation of these water resource tools in concert with water resource development projects must be proposed in the regional water supply plans. This schedule will be further refined in five-year water resource development work plans, five-year water supply plan updates, annual budget reviews, periodic rule updates, and consumptive use permit renewals. Processes for contingency planning will also be developed to address uncertainties in the fulfillment of the water supply plans with the goal of complying with state requirements for the protection of existing legal users and environmental resources.

## Water User and Natural System Assurances

The level of assurances to protect existing legal water users and the natural systems (assurances) while implementing the regional water supply plans must be consistent with Chapter 373, F.S. In this implementation process, the District's Governing Board will be faced with many policy decisions regarding the application and interpretation of law. The unique legal, technical, economical, and political implications of the regional water supply plans will all be considered in making these policy decisions. The District will be facing many of these issues for the first time in terms of their scale and significance.

The subject of assurances has been addressed in other forums, particularly in the *Central and Southern Florida Project Comprehensive Review Study Final Integrated Feasibility Report and Programmatic Environmental Impact Statement* (Restudy) (USACE and SFWMD, 1999). Although these assurances were developed in the context of the Restudy implementation, such assurances are applicable to implementation of regional water supply plan recommendations under state law and have been approved by the District's Governing Board. The Governing Board directs staff to implement the LEC Plan in accordance with the following assurances:

### 10.2.9. Assurances To Water Users

> The concept of "assurances" is key to the successful implementation of the Comprehensive Plan. Assurances can be defined in part as protecting, during the implementation phases of the Comprehensive Plan, the current level(s) of service for water supply and flood protection that exist within the current applicable Florida permitting statutes. Assurances also involve protection of the natural system.
>
> The current C&SF Project[1] has generally provided most urban and agricultural water users with a level of water supply and flood protection adequate to satisfy their needs. Florida law requires that all reasonable beneficial water uses and natural system demands be met. However, the C&SF Project, or regional system, is just one source of water for south Florida to be used in concert with other traditional and alternative water supplies.

1. C&SF Project refers to the Central and Southern Florida Project for Flood Control and Other Purposes.

The Governor's Commission for a Sustainable South Florida developed a consensus-based set of recommendations concerning assurances to existing users, including the natural system (GCFSSF, 1999). The following text is taken from the Commission's *Restudy Plan Report*, which was adopted on January 20, 1999:

*"Assurances are needed for existing legal users during the period of plan implementation. It is an important principle that has helped gain consensus for the Restudy that human users will not suffer from the environmental restoration provided by the Restudy. At the same time, assurances are needed that, once restored, South Florida's natural environment will not again be negatively impacted by water management activities. Getting 'from here to there' is a challenge. The implementation plan will be the key to assuring predictability and fairness in the process.*

*Protecting Current Levels of Service (Water Supply and Flood Protection) during the Transition from the Old to the New C&SF Project.*

*The goal of a sustainable South Florida is to have a healthy Everglades ecosystem that can coexist with a vibrant economy and quality communities. The current C&SF Project has generally provided most urban and agricultural water users with a level of water supply and flood protection adequate to satisfy their needs. In fact, if properly managed, enough water exists within the South Florida system to meet restoration and future water supply needs for the region. However, past water management activities in South Florida, geared predominantly toward satisfying urban and agricultural demands, have often ignored the many needs of the natural system (GCSSF, 1995; transmittal letter to Governor Chiles, p. 2). Specifically, water managers of the C&SF Project historically discharged vast amounts of water to tide to satisfy their mandate to provide flood protection for South Florida residents, oftentimes adversely impacting the region's estuarine communities.*

*The Commission recommended that in the Restudy, the SFWMD and the Corps[1] should ensure that the redesign of the system allows for a resilient and healthy natural system (GCSSF, 1995; p. 51) and ensure an adequate water supply and flood protection for urban, natural, and agricultural needs (GCSSF, 1996a; p.14). In response to the need to restore South Florida's ecosystem, and in light of the expected future increase of urban and agricultural water demands, the Restudy aims to capture a large percentage of water wasted to tide or lost through evapotranspiration for use by both the built and natural systems. In order to maximize water storage, the Restudy intends to use a variety of technologies located throughout the South Florida region so that no one single area bears a disproportionate share of the storage burden. This direction reinforces the Commission's recommendation that water storage must be achieved in all areas of the South Florida system using every practical option (GCSSF, 1996a; p. 25).*

*However, concerns have been expressed that a water user would be forced to rely on a new water storage technology before that technology is capable of*

1. U.S. Army Corps of Engineers

*fully providing a water supply source or that existing supplies would otherwise be transferred or limited, and that the user would thereby experience a loss of their current legal water supply level of service. Any widespread use of a new technology certainly has potential limitations; however, the Restudy should address technical uncertainties prior to project authorization and resolve them before implementation in the new C&SF Project. With the addition of increased water storage capabilities, water managers will likely shift many current water users to different water sources.*

*Additionally, stakeholders are concerned that a preservation of the current level of service for legal uses would not encompass all the urban uses, some of which are not incorporated in the term 'legal' and covered by permit. Specifically, an adequate water supply is needed to address urban environmental preservation efforts as well as water level maintenance to reduce the impact of salt water intrusion.*

*The Commission believes that in connection with the Restudy, the SFWMD should not transfer existing legal water users from their present sources of supply of water to alternative sources until the new sources can reliably supply the existing legal uses. The SFWMD should implement full use of the capabilities of the new sources, as they become available, while continuing to provide legal water users as needed from current sources. It is the Commission's intent that existing legal water users be protected from the potential loss of existing levels of service resulting from the implementation of the Restudy, to the extent permitted by law.*

*The Commission also recognizes that the SFWMD cannot transfer the Seminole Tribe of Florida from its current sources of water supply without first obtaining the Tribe's consent. This condition exists pursuant to the Seminole Tribe's Water Rights Compact, authorized by Federal (P.L[1]. 100-228) and State Law (Section 285.165, F.S.).*

*However, the issues surrounding the development of specific assurances to water users are exceedingly complex and will require substantial additional effort to resolve.*

*RECOMMENDATION*

- *The SFWMD and the Corps should work with all stakeholders to develop appropriate water user assurances to be incorporated as part of the Restudy authorizations. These water user assurances should be based on the following principles:*

  *A. Physical or operational modifications to the C&SF Project by the federal government or the SFWMD will not interfere with existing legal uses and will not adversely impact existing levels of service for flood management or water use, consistent with State and federal law.*

1. P.L. refers to Public Law

*B. Environmental and other water supply initiatives contained in the Restudy shall be implemented through appropriate State (Chapter 373 F.S.) processes.*

*C. In its role as local sponsor for the Restudy, the SFWMD will comply with its responsibilities under State water law (Chapter 373 F.S.).*

*D. Existing Chapter 373 F.S. authority for the SFWMD to manage and protect the water resources shall be preserved.*

*Water Supply for Natural Systems*

*Concerns have been raised about long term protection of the Everglades ecosystem. According to WRDA 1996[1], the C&SF Project is to be rebuilt 'for the purpose of restoring, preserving, and protecting the South Florida ecosystem' and 'to provide for all the water-related needs of the region, including flood control, the enhancement of water supplies, and other objectives served by the C&SF Project.'*

*Environmental benefits achieved by the Restudy must not be lost to future water demands. When project implementation is complete, there must be ways to protect the natural environment so that the gains of the Restudy are not lost and the natural systems, on which South Florida depends, remain sustainable.*

*A proactive approach which includes early identification of future environmental water supplies and ways to protect those supplies under Chapter 373 F.S. will minimize future conflict. Reservations for protection of fish and wildlife or public health and safety can be adopted early in the process and conditioned on completion and testing of components to assure that replacement sources for existing users are on line and dependable. The SFWMD should use all available tools, consistent with Florida Statutes, to plan for a fair and predictable transition and long term protection of water resources for the natural and human systems.*

*Apart from the more general goals of the Restudy, there are specific expectations on the part of the joint sponsors - the State and the federal government. The more discussion that goes into an early agreement on expected outcomes, the less conflict there will be throughout the project construction and operation.*

*RECOMMENDATIONS*

- *The SFWMD should use the tools in Chapter 373 F.S. to protect water supplies necessary for a sustainable Everglades ecosystem. This should include early planning and adoption of reservations. These reservations for the natural system should be conditioned on providing a replacement water source for existing legal users which are consistent with the public interest. Such replacement sources should be determined to be on line and dependable before users are required to transfer.*

1. The Water Resource Development Act of 1996 (WRDA 1996) is legislation passed by the U.S. Congress that authorized the Restudy, the Water Preserve Area Feasibility Study, etc.

- *The SFWMD should expeditiously develop a 'recovery plan' that identifies timely alternative water supply sources for existing legal water users. The recovery plan should consist of water supply sources that can reliably supply existing uses and whose development will not result in a loss of current levels of service, to the extent permitted by law. To assure that long term goals are met, the State and federal governments should agree on specific benefits to water users, including the natural system, that will be maintained during the recovery.*

- *In the short term, the Restudy should minimize adverse effects of implementation on critical and/or imperiled habitats and populations of State and federally listed threatened and/or endangered species. In the long term, the Restudy should contribute to the recovery of threatened species and their habitats.*

*Protecting Urban Natural Systems and Water Levels*

*Water supply for the urban environment is connected to water supply for the Everglades and other natural areas targeted for restoration and preservation under the Restudy.*

*It is essential that the Restudy projects proposed to restore and preserve the environment of the Everglades do not reduce the availability of water to such an extent in urban areas that the maintenance of water levels and the preservation of natural areas becomes physically or economically infeasible.*

*The successful restoration of Everglades functions is dependent not only upon the establishment of correct hydropatterns within the remaining Everglades, but also upon the preservation and expansion of wetlands, including those within urban natural areas that once formed the eastern Everglades. Some of the westernmost of these areas have been incorporated in the Restudy as components of the WPAs[1]. However, the on-going preservation efforts of local governments have acquired hundreds of millions of dollars worth of additional natural areas for protection both inside and outside of the WPA footprint.*

*Water supplies for these urban wetlands are not covered by existing permits or reservations and are therefore, not adequately protected. Efforts are underway at both the SFWMD and the local level to preserve these vital areas and assure their continuing function as natural areas and in ecosystem restoration.*

*Detailed design for the Restudy, in particular the detailed modeling associated with the WPA Feasibility Study[2], will make possible plans to protect these urban wetlands from damage and to assure maximum integration with Restudy components.*

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1. Water Preserve Areas
2. The Water Preserve Areas Feasibility Study, scheduled for completion in 2001, is investigating methods to capture and store excess surface waters that are normally released to tide via the C&SF Project canal system.

*RECOMMENDATIONS*

- *The SFWMD and the Corps should acknowledge the important role of urban natural areas as an integral part in the restoration of a functional Everglades system. As a part of the implementation plan, the SFWMD and the Corps should develop an assurance methodology in conjunction with the detailed design and modeling processes, such as the WPA Feasibility Study, to provide the availability of a water supply adequate for urban natural systems and water level maintenance during both implementation and long term operations.*

- *Expand and accelerate implementation of the WPAs. Accelerate the acquisition of all lands within the WPA footprint to restore hydrologic functions in the Everglades ecosystem, and ensure hydrologic connectivity within the WPA footprint. The WPA Feasibility Study process should be given a high priority. The WPA concept should be expanded into other SFWMD planning areas such as the Upper East Coast.*

- *The Restudy should assure that the ecological functions of the Pennsuco wetlands are preserved and enhanced."*

There is a substantial body of law that relates to the operation of Federal flood control projects, both at the state and Federal level. Much of the Governor's Commission language is directed to the South Florida Water Management District and matters of state law. To the extent that the Governor's Commission's guidance applies to the Corps' actions, the Corps will give it the highest consideration as Restudy planning proceeds and as plan components are constructed and brought on-line consistent with state and Federal law. The recommended Comprehensive Plan does not address or recommend the creation or restriction of new legal entitlements to water supplies or flood control benefits.

## Regulatory Implementation

### Introduction

The purpose of this discussion is to outline the relationship and distinction between the planning process and the regulatory implementation of the LEC Plan. In order to understand how these two water management components work together, it is helpful to know the limits and scope of each. This section describes the planning level vision of the regulatory component. It is essential that the regulatory component described below be viewed as a flexible framework for implementing actions. During development of the rules and other agency actions necessary to implement the regulatory component, public input and District Governing Board direction will be incorporated to further refine this framework.

The water supply plan contains descriptions of structural, regulatory, and operational elements, along with procedures by which the elements will be implemented. Planning evaluations are conducted with a set of assumptions and approximations that may change over time with variations in social and economic factors of the region. While

a plan does evaluate cumulative impacts of existing and potential water withdrawals, the plan is not a master permit, nor does it predetermine decisions to be made in the permit review process.

The relatively local variations occurring on a project-by-project basis are not anticipated to have regional, or otherwise significant, implications on the implementation of the regional water supply plan objectives. In order to address the local and regional impacts of water uses on a day-to-day basis, the District utilizes its statutory authorities in regulating the consumptive use of water. When used in conjunction with a regional water supply plan, the Consumptive Use Permitting (CUP) regulatory process is able to prevent over allocation of regional and localized water resources and to assure a level of certainty for permitted users, exempt users, and the environment.

The LEC Plan contains projections for both the water supply and demand estimates over the next twenty years and time frames for expansion of water supplies to meet urban, agricultural, and environmental needs. In addition, protocols for the delivery of water to the natural system and consumptive uses have also been evaluated in the plan. In order to ensure water supplies are used for their intended purposes, or to protect against water supplies being taken away from such intended uses, the District will use its regulatory authority to implement water shortage cutbacks during drought, reserve water from CUP allocation for the natural system and public health and safety, and protect water supplies designated for permit holders.

In order to achieve the regulatory goals of the regional water supply plan, the District will develop rules and implement the rules consistent with state law. However, this raises the following question: If the rule development and implementation process is separate from the plan, how can the public be assured that the resulting rules will be consistent with the plan? This assurance is provided through the administrative procedures outlined in state law under Chapter 120, F.S. Both rulemaking and formal agency actions of the District must comply with requirements affording substantially affected parties the opportunity to participate in the rule development process and to challenge proposed rules, existing rules, and final and proposed agency action.

Should the rulemaking and its intended and unintended effects deviate from performance measures used in the plan, the Governing Board may direct staff to conduct additional evaluations to supplement the planning level evaluations that support the proposed rule, or revise the draft rule consistent with the planned performance measures. In addition, opportunities for public involvement in identifying contingency actions necessary to implement additional water resource development projects by proposed rules are outlined in the **Contingency Planning** section on **page 203** of this chapter.

It has been determined that the existing system used to deliver water throughout the region presents significant constraints on environmental restoration. As a result, significant structural changes, to be completed over time, are necessary to restore hydropatterns in regional natural systems. Therefore, the amounts of water to be delivered and protected, and the timing and sources of supply to be incorporated under reservation rules and other resource protection standards described below will evolve with the

implementation of water resource development projects. Florida law is well suited to deal with the changing water supply situation in South Florida that occurs as the water resource development projects outlined in the Comprehensive Everglades Restoration Plan (CERP) and LEC plans are implemented.

The need for flexibility in implementing a phased restoration project raises the following question: What assurances are there that the identified future sources of environmental water supply, including reservations, will not be permitted away? Several factors associated with the implementation of this plan address this concern. First, the plan includes water resource development projects that provide adequate supplies of water through a 1-in-10 year drought condition, to meet the needs of both the environmental restoration and permitted water uses by 2020 to the greatest extent possible. The environment and consumptive uses will not need to compete for water. Secondly, the proposed CUP rules contain provisions to limit new demands on the regional system as the water resource development/CERP projects are being constructed. These include limiting the amounts of regional water that can be allocated to each service area in five-year increments based on the results of the planning analysis. If cumulative regulatory evaluations indicate that the five-year limitations on regional water allocations have been reached, new or increased demands will be met through alternative and local (independent of the regional system) supplies until additional water is available. Also, existing supplies can be more efficiently utilized to meet increasing demands until additional regional supplies are made available. As part of this process, it is envisioned that both CUP water supplies and environmental water reservations will be updated every five years as necessary to reflect changed water supply availability as the projects associated with this plan are completed.

Should the water supply needs of the natural system or consumptive uses exceed the projections in the LEC Plan, the District will utilize the planning process to develop alternative water resources and avoid competition to the greatest degree possible. Assurances set forth in this plan and the contingency planning efforts will be applied to protect both consumptive uses and the natural system while alternative sources as being developed.

As one of the tools for plan implementation, rulemaking to implement the regulatory recommendations of the LEC Plan will constitute a significant effort during the next several years. Rulemaking will include water reservations and numerous CUP criteria, which are interrelated and cumulatively define the availability of water for consumptive uses and water resource protection. As a result, it is recommended in the LEC Plan that certain rulemaking efforts be grouped in phases to allow for the cumulative analysis of the water resource and consumptive use implications of the regulatory program.

Another goal of the rulemaking schedule is to adopt rules as the technical information becomes available. As a result, it is recommended in this plan that initial rulemaking proceed for concepts that were sufficiently identified and evaluated in the planning process. These include establishment of MFLs for the Everglades, Lake Okeechobee, the Biscayne Aquifer, and the Caloosahatchee River.

In addition, uncertainties in the rulemaking process, such as delays for development of supporting technical data or rule challenges, may conflict with the proposed schedule for rule development provided in this plan. The proposed schedule will be adapted to account for such delays, while considering the need to develop associated rules through a coordinated rulemaking process. The contingency process identified in the plan, along with input from the LEC Regional Water Supply Plan Advisory Committee, other members of the public, and the Governing Board may be used to identify necessary changes to the rulemaking schedule.

The following sections give a brief overview of the legal and policy issues associated with the major tools for implementing the regulatory component of the regional water supply plan discussed above. This discussion should be read in context of the LEC Plan as a whole, and is not intended to be inclusive of all of the relevant legal and policy factors considered in development and implementation of the plan.

## Water Reservations

### Legal Description

Section 373.223(4), F.S., provides the following in relevant part:

> The governing board or the department, by regulation, may reserve from use by permit applicants, water in such locations and quantities, and for such seasons of the year, as in its judgment may be required for the protection of fish and wildlife or the public health and safety.

The statute also provides that reservations are subject to periodic review based on changed conditions. This provides flexibility to account for changes in implementation strategies and contingency plans during the next 20 years. A specific level of protection is also provided to existing legal users when establishing reservations. Existing legal users are protected insofar as they are “not contrary to the public interest” (Section 373.223(4), F.S.).

### Reservation Implementation Policies

Reservations will reflect environmental enhancement and protection goals and objectives consistent with the Restudy hydropattern achievable by 2020, based on the degree of CERP implementation expected within that time frame. When appropriate, rain-driven formulas will be used to determine reservation quantities. Reservations will incrementally delineate and protect the volume and timing of necessary environmental water supply deliveries. Likewise, consumptive use demands under conditions up to and including a 1-in-10 year drought event are estimated and will be incrementally protected through consumptive use permits. Water shortage provisions (see below) will govern the actions of the District in providing shared adversity to both the natural system under rain-driven formulas and consumptive users for conditions beyond the 1-in-10 drought year level of certainty.

Water availability and its delivery for environmental purposes will increase as water resource development projects are constructed. Initial and incremental increases in water reservations to provide increased water deliveries to the natural system shall be contingent upon availability of water from water resource development projects provided to augment existing supplies or create new supplies to meet such demands.

The reservation rule will include a description of the ultimate 2020 restoration deliveries to the natural system. The rule will also account for potential changes to reflect refinement of the project designs or restoration targets. The rule will incorporate the list and description of the water resource development projects and amounts of water potentially to be made available for the reservation upon deployment. Finally, the rule will include water supply formulae and protocols to define the amount and timing of water supply deliveries based on the remaining constraints on the regional system. As new water resource development projects are constructed, the rule will be revised to include the resulting improvements in deliveries. A series of water resource development projects that will provide water to meet MFL targets and reservations are listed in **Table 51**. The anticipated completion date of each of these options is also included.

Water reservations rules will be drafted for Everglades National Park, the Water Conservation Areas (WCAs), and the Holey Land and Rotenberger Wildlife Management Areas (WMAs) by 2003. Everglades National Park staff requested that the rain-driven schedules currently being developed by the District be utilized for the initial reservation instead of the existing rain-driven formula that is being used to deliver water to the park. Additional reservation rules for Florida Bay, Biscayne Bay, Loxahatchee Slough and River, the Caloosahatchee and St. Lucie estuaries, and subregional wetlands (in Palm Beach, Broward, and Miami-Dade counties including the Model Lands and south Miami-Dade wetlands) will be undertaken as supporting technical research is concluded and water supplies to meet the natural system demands are made available. In the interim (2000-2004), until reservations can be defined or the CERP implemented, the above water bodies will receive, to the greatest extent practicable, similar water deliveries through time as generally reflected in the incremental performance of the LEC Plan. The systemwide operational protocols, as developed under **Recommendation 31** of this plan, will include, to the greatest extent practicable, the operational assumptions reflected in the South Florida Water Management Model (SFWMM) for the recommended alternative and time horizon.

## Consumptive Use Permitting

### Legal Description

Under Section 373.219, F.S., the yield of the source, or amount of water which can be permitted for use, is limited, in part, by the resource protection criteria which define when harm will occur to the resource. Resource protection criteria have been adopted by the water management districts pursuant to Section 373.223, F.S. This section requires that all consumptive uses must be reasonable-beneficial. For consumptive uses to be considered reasonable-beneficial they must be efficient, consistent with the public interest, and not interfere with other presently existing legal uses. The aim of the reasonable-

**Table 51.** Water Resource Development Projects that Provide Water Supplies Associated with MFL Recovery Plans and Water Reservations.

| Water Body | Basis of Reservation | Water Supply Development Projects | Year Water Reservation Rule Will Be Developed[a] |
|---|---|---|---|
| Everglades National Park | Rain-driven/ Stage formula | Everglades Construction Project | 2005 |
| | | Modified Water Deliveries to Everglades National Park | 2005 |
| | | C-111 Operational Modifications[b] | 2005 |
| | | L-31 Levee Improvements | 2010 |
| | | WCA-3A and WCA-3B Seepage Management | 2010 |
| | | Decompartmentalize WCA-3A, Phase I | 2010 |
| | | Decompartmentalize WCA-3A, Phase II | 2020 |
| | | West Miami-Dade County Reuse (50 MGD) | 2020 |
| | | Central Lake Belt Storage Area (92,160 acre-ft [ac-ft]) | 2021 |
| WCAs and Everglades National Park | Rain-driven/ Stage formula | EAA Storage Reservoir, Compartment 1 (180,000 ac-ft) | 2010 |
| | | EAA Storage Reservoir, Compartment A (120,000 ac-ft) | 2010 |
| | | EAA Storage Reservoir, Compartment B (60,000 ac-ft) | 2015 |
| | | Taylor Creek/Nubbins Slough Reservoir (50,000 ac-ft) | 2010 |
| | | Lake Okeechobee ASR, Phase 1 (500 MGD) | 2015 |
| | | Lake Okeechobee ASR, Phase 2 (1,000 MGD) | 2020 |
| | | North of Lake Okeechobee Storage Reservoir | 2015 |
| St. Lucie Estuary | Salinity envelope criteria | C-44 Basin Storage Reservoir (30,000 ac-ft) | 2010 |
| Caloosahatchee Estuary | Salinity envelope criteria | C-43 Basin Storage Reservoir | 2010 |
| | | C-43 Basin ASR (220 MGD) | 2015 |
| Stormwater Treatment Areas (STAs)[c] | Six-inch minimum depth | Lake Okeechobee Storage | 2005 |
| Loxahatchee River | Salinity envelope criteria | C-51 and Southern L-8 Reservoir | 2015 |
| | | West Palm Beach Water Catchment Area ASR[d] | 2015 |
| Biscayne Bay Florida Bay | Salinity envelope criteria | Construction of S-356 Structures and Relocation of a Portion of L-31N Borrow Canal | 2010 |
| | | South Miami-Dade County Reuse (131 MGD) | 2020 |
| | | Central Lake Belt Storage Area (92,160 ac-ft) | 2021 |
| | | North Lake Belt Storage Area (45,000 ac-ft) | 2021 |

a. These dates to complete MFLs are taken from a letter from SFWMD to FDEP dated November 15, 1999.
b. C-111 Operational Modifications are part of the Modification to South Dade Conveyance System in Southern Portion of L-31N and C-111 Canals component
c. MFL criteria are not applicable to this water body.
d. The West Palm Beach Water Catchment Area ASR is part of the L-8 Project.

beneficial requirement is to prevent saltwater intrusion and saline water upconing, harm to wetlands and other surface waters, aquifer mining, and pollution.

Harm in the resource protection framework proposed in this plan refers to adverse impacts that require one to two years of average rainfall to recover. Within this document, harm, for purposes of allocating water, occurs when adverse impacts to water resources that occur during dry conditions are sufficiently severe that they cannot be restored within a period of one to two years of average rainfall conditions. These short-term adverse impacts will be addressed under the CUP Program, which calculates allocations to meet demands for use during relatively mild, dry season conditions. The harm criteria will not be exceeded for hydrologic conditions through a 1-in-10 year drought event and permitted allocations will be based on demands up to and including the 1-in-10 year level of certainty.

## Consumptive Use Permitting Implementation Policies

The following excerpts from Chapter 373, F.S., provide the basic level of protection given to existing legal users under the law:

> The governing board shall act with a view to full protection of the existing rights to water insofar as is consistent with the purpose of this law [Section 373.171(2), F.S.].
>
> No rule, regulation or order shall require any modification of existing use or disposition of water in the district unless it is shown that the use or disposition proposed to be modified is detrimental to other water users or to the water resources of the state [Section 373.171(3), F.S.].

Projects to supply water to benefit consumptive users shall be prioritized to first meet existing reasonable-beneficial water demands with a 1-in-10 year level of certainty, and then to meet increasing future demands.

Water supplies necessary to meet increasing reasonable-beneficial demands will be contingent upon the demonstrated availability of the water resources to supply required volumes, the performance of water resource development projects identified to augment or create supplies to meet such demands, and the applicant's water supply development strategy for meeting the specified demands. Water availability for future permit allocation will be defined by many factors, including the following:

- Extent to which the resource has been successfully used by the applicant in the past
- Extent to which the particular source is expected to be developed for use and the timing of such demand increases
- Extent to which the water supply source derives water from the regional system versus local storage
- Extent to which the source is being diverted for nonconsumptive uses (e.g., reservations) and the timing of such diversions

- Extent to which a particular use was considered in the regional water supply planning process, the short-term and long-term demand projections for such use, and conservation of water supplies
- Identified water resource development projects and timing of implementation

Once the 1-in-10 year level of certainty criteria is established by rule, permits will be issued based on the applicant's ability to provide reasonable assurances that demands are reasonable, water resources will be protected, and that issuance of the permit will not interfere with existing legal users. For existing projects that have been operational during a 1-in-10 year drought without water resource harm or existing legal user interference, the historical performance of the project will be considered in providing reasonable assurances that the conditions for permit issuance are met upon permit renewal.

## Implementation of Minimum Flows and Levels Recovery and Prevention Strategies

### Legal Description

MFLs are established pursuant to Section 373.042, F.S., A detailed description of the process and factors for establishing MFLs is included in the document entitled *Minimum Flows and Levels for Lake Okeechobee, the Everglades, and Biscayne Aquifer* (SFWMD, 2000e).

Section 373.0421, F.S., requires that once the MFL technical criteria have been established, the Districts must develop and expeditiously implement a recovery and prevention strategy for those water bodies that are currently exceeding, or are expected to exceed, the MFL criteria. Section 373.0421(2), F.S., provides the following in relevant part:

> The recovery or prevention strategy shall include phasing or a timetable which will allow for the provision of sufficient water supplies for all existing and projected reasonable-beneficial uses, including development of additional water supplies and implementation of conservation and other efficiency measures concurrent with to the extent practical, and to offset, reductions in permitted withdrawals, consistent with the provisions of this chapter.

### Minimum Flows and Levels Strategy Implementation Policies

It is possible that the proposed MFL criteria cannot be achieved immediately, because of the lack of adequate regional storage and/or ineffective water distribution infrastructure. These storage and infrastructure shortfalls will be resolved through water resource development and water supply development projects, construction of facilities, and improved operational strategies that will increase the region's storage capacity and improve the existing delivery system. Planning and regulatory efforts will, therefore,

include a programmed recovery process that will be implemented over time to improve water supply and distribution to protect water resources and functions. The recovery process includes the following:

- Necessary structural solutions for the recovery and prevention plan will be provided in the form of a list of projects. The list will include the timing and funding requirements for each project. **Table 51** provides a list of the various water resource development projects identified in the LEC Plan that will provide water to meet the proposed MFL targets and water reservations. **Table 51** also includes anticipated completion dates of these projects. In addition, **Tables 53**, **54**, and **55** provide the amounts of water projected to be delivered to each area by components to meet the proposed MFLs.
- If necessary to prevent the MFL criteria from being exceeded, demand management cutbacks for recovery during drought conditions will also be identified (e.g., phased water shortage restrictions to prevent significant or serious harm). The LEC Plan does not propose the use of the Water Shortage Plan as a MFL recovery strategy. However, when a drought occurs, the District will rely upon the Water Shortage Plan, as necessary, to address regional water availability. This strategy is discussed below.
- To the extent practicable, the District shall implement water deliveries to reduce or prevent the MFL criteria from being exceeded. Operational guidelines necessary for implementation of water supply deliveries to achieve MFLs, in concert with meeting other required water demands, will be identified. However, water deliveries to prevent the MFL criteria from being exceeded will be given priority consideration over deliveries for other purposes.
- Before considering reduction in permitted withdrawals in a recovery and prevention strategy, all practical means to prevent reductions in available water supplies for consumptive use shall be explored and implemented. When determining whether reductions in existing legal uses are required, the following factors shall be considered:
    - The extent of MFL shortfall directly caused by existing legal uses
    - The practicality of avoiding the need for reductions in permitted supplies, including structural and operational measures, by maximizing the beneficial uses of the existing water source
    - The risk of significant harm resulting from the existing legal use in the interim period before the recovery strategy is fully implemented

## Water Shortage Implementation

### Legal Description

Pursuant to Section 373.246, F.S., water shortage declarations are designed to prevent serious harm from occurring to water resources. Serious harm, the ultimate harm to the water resources that was contemplated under Chapter 373, F.S., can be interpreted as long-term, irreversible, or permanent impacts. The District will develop and adopt water shortage triggers to avoid causing harm, significant harm, and serious harm to water resources, in conjunction with the implementation of the District's Water Shortage Plan (Chapter 40E-21, F.A.C.). Water resource triggers will be identified for the imposition of water shortage restrictions, taking into consideration climatic events, continued decline in water levels, and a need to curtail human demand to correspond to decreasing supplies. These restrictions act to apportion among uses, including the environment, a shared adversity resulting from a drought event. Adoption of the resource protection criteria as water shortage trigger indicators also serves the purpose of notifying users of the risks of water shortage restrictions and potential for loss associated with these restrictions.

### Water Shortage Implementation Policies

When evaluating options for users and the natural system during droughts, the District will consider the extent to which consumptive use withdrawals influence water levels in the natural system and the extent to which natural system water levels are deviating from rain-driven formula targets for the associated level of drought. Adversity to existing legal users is measured in terms of projected economic losses.

Water supply demands defined by rain-driven formulas, naturally decrease with increased drought levels, while consumptive use demands increase. For this reason, water delivery cutbacks to the natural systems during droughts should not be necessary. An exception to this could occur if the delivery of rainfall-based supplies causes greater environmental harm elsewhere in the natural system. Under this scenario, the Governing Board, after considering all of the specific facts, and in consultation with the public, may order temporary reductions in natural system deliveries in order to protect more vulnerable portions of the natural system from further harm.

Even though water shortage triggers were established and met in the model simulations performed during the LEC regional water supply planning process, actual water restrictions will be determined on a case-by-case analysis for a given drought event. Thus, prior to declaring a water shortage, the District will also analyze the factors listed in the Water Shortage Plan concerning such issues as 1) whether or not sufficient water will be available to meet the estimated and anticipated user demands, and 2) whether serious harm will occur to the water resource. Another exception could occur if severe fires are burning in the Everglades Protection Area, especially in peat wetlands, and delivery of additional water may be needed to help stop the fires.

## Contingency Planning

The timing of physical, regulatory, or operational modifications required to implement the regional water supply plan will be coordinated, to the extent practicable, to avoid reductions in water supplies for environmental restoration and consumptive use demands. If, however, practicable measures are not available, the District will provide a contingency plan that is designed to optimize the use of available water supplies, until the long-term source augmentation is implemented.

The regional water supply plans will be updated at least every five years to incorporate contingency methods, as required by law. If significant changes in planning assumptions occur during the five-year intervals and require the plan to be revisited, updates may occur, as appropriate, more often. This determination will be, in part, based on annual status updates to the Florida Department of Environmental Protection (FDEP) and the Florida Legislature and CERP annual status updates.

If the determination is made that contingencies need to be implemented, the process to accommodate these changes will include meetings of the LEC Regional Water Supply Advisory Committee and redirection of staff and resources through the five-year water resource development work plans and the annual budget process.

The District will establish a process for identifying opportunities to provide water supply benefits to natural systems on an annual or seasonal basis when surplus water supplies exist, after considering the permitted demands of consumptive uses. Opportunities to deliver such water supplies through operational flexibility will be examined and implemented, after consideration by the District's Governing Board, as appropriate. The operational flexibility recommendations are discussed further in **Chapter 6** on **pages 307** through **312**.

## Public Involvement in the CERP Implementation Process

The Restudy was developed through an inclusive and open process that engaged many stakeholders. All applicable federal, tribal, state, and local agencies were full partners and their views were fully considered. The implementation process for the CERP will continue this effort and facilitate project modifications that are needed to take advantage of what is learned from system responses and as future restoration targets become more refined.

For construction features, work will be conducted in planning, engineering and design, real estate acquisition, and construction. Where appropriate, pilot projects will be conducted to resolve uncertainties before additional planning efforts are undertaken. Operations, maintenance, repair, replacement, and rehabilitation costs will be assessed to determine the continuing costs of each feature once it is constructed. Operational strategies and criteria, such as rain-driven water delivery schedules, will be implemented to achieve maximum benefits from the features in place at any given time. In addition, a comprehensive monitoring and adaptive assessment program (REstoration, COordination

and VERification [RECOVER]) will be undertaken to assess systemwide conditions and responses and to provide guidance in the design and operation of components.[1]

The RECOVER team will be particularly important to the LEC Regional Water Supply Plan Advisory Committee, since they will be tracking both systemwide performance and regional water contributions that will be realized from specific projects. The committee will request that the RECOVER team consult with them regarding contingency provisions that may alter assumptions used in the LEC Plan, as well as seek their input regarding other CERP directions and efforts.

Project Implementation Reports (PIRs) will be developed for each CERP component. These will include evaluations to ensure the maintenance or improvement of flood protection and evaluations of the potential for recreational development. Because PIRs will require the approval of the District's Governing Board, the LEC Regional Water Supply Plan Advisory Committee can provide comments regarding the PIRs. Public input to the PIR process will help in the determination of the locations, capabilities, and general design features of the components. In addition, public input to the PIR process will be sought and provided through the required completion of the National Environmental Policy Act documentation.

In addition, the LEC Regional Water Supply Plan Advisory Committee can provide recommendations to the District regarding feasibility studies. Two feasibility studies (the Water Preserve Areas Feasibility Study and the Indian River Lagoon Feasibility Study) are currently being completed. Also, the Comprehensive Integrated Water Quality Plan and three new feasibility studies (the Florida Bay Feasibility Study, the Florida Keys Feasibility Study, the Southwest Florida Study) are being undertaken. Extensive outreach and public involvement, which have been essential parts of the Restudy and the CERP, will continue during the completion of these feasibility studies.

## STATUTORY DEFINITION OF WATER RESOURCE DEVELOPMENT AND WATER SUPPLY DEVELOPMENT

The projects and actions proposed for implementation consist of projects from two categories: water resource development projects and water supply development options. This is in concert with amendments to Chapter 373, F.S., that were passed in 1997, which require that water supply plans include a water resource development component and a list or menu of water source options for water supply development that can be chosen by local water users. The statute defines water resource development and water supply development as follows:

> 'Water resource development' means the formulation and implementation of regional water resource management strategies, including the collection and evaluation of surface water and ground water data; structural and nonstructural

1. A more detailed discussion of the CERP implementation process is provided in Chapter 10 of the Restudy (USACE and SFWMD, 1999).

> programs to protect and manage water resources; the development of regional water resource implementation programs; the construction, operation, and maintenance of major public works facilities to provide for flood control, surface and underground water storage, and ground water recharge augmentation; and related technical assistance to local governments and to government-owned and privately owned water utilities.
>
> 'Water supply development' means the planning, design, construction, operation, and maintenance of public or private facilities for water collection, production, treatment, transmission, or distribution for sale, resale, or end use.

Structural and nonstructural water resource development components are identified below. These include actions necessary to implement the LEC Plan, such as MFL recovery and prevention strategies, water reservations, water shortage provisions, operational strategies, and contingency planning.

Chapter 373, F.S., requires that water supply plans include a list or menu of water source options for water supply development that can be chosen by local water users. For each source option listed, the estimated amount of water available for use, cost, potential sources of funding, and a list of projects that meet applicable funding criteria are required. In addition, water supply plans must also include a list of water resource development projects that support water supply development. For each water resource development project, estimates of the amount of water produced, timetables, funding requirements, and participants who will implement the project must also be provided.

The District is primarily responsible for the implementation of the water resource development components. Local users have primary responsibility for water supply development by choosing the water source options that will best meet their needs.

In addition to the legislative definitions described above, the designation of a component as a water resource development project was based on it having the following characteristics:

- Has the opportunity to address more than one resource issue
- Addresses a variety of use classes (e.g., environment, public water supply)
- Protects/enhances resources available for allocation
- Moves water from water surplus areas to water deficit areas
- Has a broad application of technology

The equivalent characteristics that led to designations of projects as water supply development options are as follows:

- Requires localized implementation of technology
- Delivers resources to consumers
- Has regionalized interconnects to consumer

# WATER RESOURCE DEVELOPMENT PROJECTS

Water resource development projects to be implemented as part of this plan are discussed in this section. They have been divided into the following categories:

1. Ongoing projects from the *Interim Plan for Lower East Coast Regional Water Supply* (LEC Interim Plan) (SFWMD, 1998b)
2. Other federal, state, and South Florida Water Management District projects
3. CERP projects
4. Recommendations to the CERP resulting from analysis performed during the LEC regional water supply planning process
5. Recommendations to the CERP from the *Caloosahatchee Water Management Plan* (CWMP)
6. Operational recommendations resulting from LEC regional water supply planning process analysis
7. Consumptive use permitting and resource protection projects

## Ongoing Projects from the LEC Interim Plan

The first set of water resource development projects are those that were recommended in the LEC Interim Plan (SFWMD, 1998b), have not yet been completed, and are considered appropriate for continued effort. Information regarding each of these projects is briefly discussed in **Table 52**, which also identifies the numbered recommendation in **Chapter 6** to which each project corresponds.

**Table 52.** Summary Information Regarding Water Resource Development Recommendations from the LEC Interim Plan.

| Rec. No. | Water Resource Development Project | Location in the LEC Interim Plan (pages) | Progress | Need for Continued Effort |
|---|---|---|---|---|
| **1** | Regional Saltwater Intrusion Management | 21 - 22 | Additional wells have been installed in Miami-Dade, Broward, and Palm Beach counties. | Gaps remain in the monitoring network and research and modeling need to be undertaken to better define the relationships between water levels and saltwater migration. |
| **2** | Floridan Aquifer System Ground Water Model | 23 - 24 | The initial model was developed. | A need has been identified for more data to augment and refine the model and better assist with planning and regulatory decision making. |
| **3** | Northern Palm Beach County Comprehensive Water Management Plan | 35 - 36 and 37 - 39 | The plan is almost complete and conceptual designs have been largely incorporated into the Restudy and the LEC Plan. | Plan will be completed in the summer of 2000 and implemented through the CERP and the LEC Plan. |

**Table 52.** Summary Information Regarding Water Resource Development Recommendations from the LEC Interim Plan.

| Rec. No. | Water Resource Development Project | Location in the LEC Interim Plan (pages) | Progress | Need for Continued Effort |
|---|---|---|---|---|
| **4** | Eastern Hillsboro Regional ASR Pilot Project | 47 - 49 | Biscayne aquifer wells to support the first ASR well are under construction. | The initial Floridan ASR well needs to be completed, its performance evaluated, and a decision made regarding completion of a second ASR well. |
| **5** | Hillsboro (Site 1) Impoundment Pilot Project | 45-46 | The proposed Hillsboro reservoir has been incorporated into the CERP. | The pilot project will proceed in advance of the CERP project. A small-scale reservoir will be constructed and seepage rates and collection systems evaluated. |
| **6** | Lake Worth Lagoon Minimum/Maximum Flow Targets | 109 - 111 | A preliminary hydrodynamic model has been completed. | Additional tidal amplitude and salinity data for dry and wet periods need to be collected. The effort will cover a larger area and be completed for shorter time steps than the original effort. The model needs to be updated and extended using these data. Evaluations need to be conducted to determine the impacts of inflows on biological (sea grass) communities. |
| **7** | Northern Broward County Secondary Canals Recharge Network | 63 - 64 | Three projects (two pump stations and one canal connector) have been funded. | The remainder of the network needs to be designed and constructed. |
| **8** | Southeast Broward County Interconnected Water Supply System | 65 - 66 | Facilitated sessions to achieve agreement on an integrated water supply system for southeastern Broward County are under way. | A final agreement acceptable to all parties needs to be developed and implemented. |
| **9** | Broward County Urban Environmental Enhancement | 59 - 61 | The recommendation to evaluate sources and methods to use surface water to benefit wetlands in coastal Broward County was developed through the Broward County Integrated Water Resource Plan. | This project proposes to implement the recommendation by first identifying wetland systems with needs and then evaluating the advisability of structural and regulatory programs to support the proposed environmental enhancements. |
| **10** | Miami-Dade Water and Sewer Department Utility ASR | 79 - 80 | Some of the ASR wells have been built and are undergoing testing. | Remaining proposed wells need to be constructed. |
| **11** | Biscayne Bay Minimum and Maximum Flow Targets | 113 - 114 | USACE, as part of the Biscayne Bay Feasibility Study, has been developed and is validating a hydrodynamic model. The model is a key tool in determining these targets. The USGS completed a regional ground water model. Ecological response evaluation tools may need to be developed. | To complete this work, additional hydrologic data needs to be collected, performance measures determined, and scenarios simulated and evaluated in terms of ecological responses. Work needs to be completed in close cooperation with CERP RECOVER efforts. |

## Other Federal, State, and District Projects

Two groups of projects have been included in this category. The first are those critical projects in the LEC Planning Area for which the SFWMD is local sponsor. The critical project program was authorized by congress under the Water Resources Development Act of 1996 to expeditiously implement restoration projects that are deemed critical to the restoration of the South Florida ecosystem. The federal participation in critical projects is for 50 percent of total project costs, with a maximum federal contribution on any project of $25,000,000. The three critical projects (**Recommendation 12**) included are the West Canal Structure (C-4), the Western C-11 Water Treatment Project, and the Lake Okeechobee Water Retention/Phosphorus Removal Project. The second group are three District-initiated projects (**Recommendations 13** through **15**) that effect recommendations developed in the CWMP and **Recommendation 16** regarding Mobile Irrigation Labs (MILs).

### Critical Projects (Recommendation 12)

#### West Canal Structure (C-4)

This project is being implemented as a critical project and is part of the without plan condition (2020 Base Case) used in the modeling performed for the LEC regional water supply planning process. It consists of a new structure in the C-4 Canal, immediately southeast of the Pennsuco Wetlands. It will keep higher surface and ground water levels to the west, which will reduce drainage from the Pennsuco Wetlands and the Everglades and help reestablish natural hydroperiods in these areas.

#### Western C-11 Water Treatment

This project is also being implemented as a critical project and is also part of the without plan condition (2020 Base Case) used in the modeling performed for the LEC regional water supply planning process. The purpose is to improve the quality and timing of discharges to the Everglades from the Western C-11 Basin. A gated control structure on the C-11 Canal will be used to keep seepage water from mixing with lower quality runoff water from the basin. An additional pump station will be constructed to return seepage water to the Everglades Protection Area.

#### Lake Okeechobee Water Retention/Phosphorus Removal

This critical project will restore the hydrology of wetlands in four key basins north of Lake Okeechobee using two approaches. First, it will plug drainage ditches that connect wetlands with canals and drain land to create improved pasture. This will help retain water in the wetlands and improve water quality treatment functions of the wetlands. Second, it will divert canal flows into adjacent wetlands, which will also attenuate flows and retain phosphorus.

### Well Abandonment Program (Recommendation from the CWMP) (Recommendation 13)

The CWMP has identified a problem with free-flowing, brackish aquifer wells that was not adequately addressed by the Well Abandonment Program that was administered by the District and ended in 1991. In the CWMP, it is recommended that additional efforts should be made to locate and properly abandon the free-flowing wells in the Caloosahatchee Basin. It is further recommended that the District should work with local and state officials to locate uncontrolled abandoned wells and identify strategies and applicable funding sources for proper plugging of these wells.

### Saltwater Influence at S-79 (Recommendation from the CWMP) (Recommendation 14)

The need for this project was identified in the CWMP. Historically, the upstream migration of saline water (in excess of 250 milligrams per liter) has been a recurring problem during extended periods of low flow in the Caloosahatchee River. Saline water reaches the potable water intakes in the Caloosahatchee River, which are located approximately one mile upstream of the S-79 structure. While, freshwater releases from Lake Okeechobee for environmental purposes may minimize occurrences of this problem in the future, a number of alternatives warrant further investigation. They include moving the intakes farther upstream, modifications to the structure, limiting lockages during low flow periods, and improved maintenance and operation of the bubble curtain. The proposed project would conduct additional analyses of the saline water problem and potential solutions.

### Permitting Issues Associated with ASR Systems and Reuse of Reclaimed Water (Recommendation 15)

Both the CERP and the LEC Plan recognize that the District will need to continue working with the legislature, FDEP, and the U.S. Environmental Protection Agency (USEPA) to develop and update rules and permitting procedures that will facilitate development of Aquifer Storage and Recovery (ASR) systems and application of reclaimed water while providing appropriate protection for potential users. This project provides for staff participation to handle LEC Plan implementation issues that arise as part of this larger process.

### Mobile Irrigation Labs (Recommendation 17)

This recommendation continues support for Mobile Irrigation Labs as an effective conservation support program. However, recent decisions by the Governing Board related to CERP funding have indicated that this is not a core program for funding by the District. As a result, District participation in funding will be limited to providing staff to garner support from other agencies such as FDEP, Florida Department of Agriculture and Consumer Services (FDACS), and soil and water conservation districts, as well as customers.

## Comprehensive Everglades Restoration Plan Projects (Recommendation 17)

The Central and Southern Florida Project for Flood Control and Other Purposes (C&SF Project) provides water supply and flood protection for the District. The region's hydrology is now largely governed by a man-made system superimposed on the natural one. Although it has provided for urban and agricultural uses since its inception in 1948, the C&SF Project and the greater-than-expected growth and development that have ensued have unintentionally resulted in extensive damage to the South Florida environment. Over half of the original Everglades have been destroyed and the damage continues. Water is sent to tide through events such as the very wet spring of 1998, involving over 1.4 million acre-feet (ac-ft) of emergency Lake Okeechobee flood control releases to the Caloosahatchee and St. Lucie estuaries. These releases caused major environmental, economic, and human impacts in those estuaries and later resulted in a subsequent need for the lost water as the region headed into drought conditions. Without a change to the current design and operation of the C&SF Project, forecasts project the continued loss of uplands; degradation of wetlands, estuaries, and aquatic life; increased water shortages for agricultural and urban uses; increased flooding; and the loss or forced movement of wellfields.

The keys to Everglades restoration as determined in the C&SF Project Comprehensive Review Study (Restudy) (USACE and SFWMD, 1999), are to increase the amount of water available, ensure adequate water quality, and reconnect the parts of the system. A key aim is to annually regain, for beneficial use, about two million ac-ft of excess water that is currently being discharged to tide for flood control.

The recommendations made within the Restudy (i.e. structural and operational modifications to the C&SF Project) are being further refined and will be implemented in the CERP. The CERP will be implemented by a joint federal/state/District process. The CERP includes components that will change the functioning of the C&SF Project to meet ecosystem restoration and improvement goals and provide regional system features, including water resource development capabilities, needed to meet urban and agricultural water demands through 2050. Many of these water resource development projects had been previously evaluated for the LEC Interim Plan and were further evaluated for the Restudy. Major features of the CERP include the following:

**Surface Water Storage Reservoirs.** A number of water storage facilities are planned north of Lake Okeechobee, in the Caloosahatchee and St. Lucie basins, in the Everglades Agricultural Area (EAA), and in the Water Preserve Areas of Palm Beach, Broward, and Miami-Dade counties. These areas will encompass approximately 181,300 acres and will have the capacity to store 1.5 million ac-ft of water.

**Water Preserve Areas.** Multipurpose water management areas are planned in Palm Beach, Broward, and Miami-Dade counties between the urban areas and the eastern Everglades. The Water Preserve Areas will have the ability to treat urban runoff, store water, reduce seepage, and improve existing wetland areas.

**Manage Lake Okeechobee as an Ecological Resource.** Lake Okeechobee is currently managed for many, often conflicting, uses. The lake's regulation schedule will be modified and plan features constructed to reduce the extreme high and low levels that damage the lake and its shoreline. Management of intermediate water levels will be improved, while allowing the lake to continue to serve as an important source for water supply. Several projects to improve water quality conditions in the lake are included. A study is recommended to evaluate in detail the dredging of nutrient-enriched lake sediments to help achieve water quality restoration targets, important not only for the lake, but also for downstream receiving bodies.

**Improve Water Deliveries to Estuaries.** Excess storm water that is discharged to the ocean and the gulf through the Caloosahatchee and St. Lucie rivers is very damaging to their respective estuaries. Excess runoff will be stored in surface and underground water storage areas to reduce these discharges. During times of low rainfall, the stored water can be used to augment flow to the estuaries. Damaging high flows will also be reduced to the Lake Worth Lagoon.

**Aquifer Storage and Recovery.** Wells and associated infrastructure will be built to store water in the upper Floridan aquifer. As much as 1.6 billion gallons a day may be pumped down the wells into underground storage zones. The injected fresh water, which does not mix with the saline aquifer water, is stored in a bubble and can be pumped out during dry periods. This approach, known as Aquifer Storage and Recovery (ASR), has been used for years on a smaller scale to augment municipal water supplies. Since water does not evaporate when stored underground, and less land is required for storage, ASR has some advantages over surface storage. ASR wells will be constructed around Lake Okeechobee, in the Water Preserve Areas, and in the Caloosahatchee Basin.

**Stormwater Treatment Areas.** Approximately 35,600 acres of man-made wetlands, known as Stormwater Treatment Areas (STAs), will be built to treat urban and agricultural runoff water before it is discharged to the natural areas throughout the system. STAs are included in the Restudy for basins draining to Lake Okeechobee, the Caloosahatchee River Basin, the St. Lucie Estuary Basin, the Everglades, and the Lower East Coast urban areas. These are in addition to the over 44,000 acres of STAs already being constructed pursuant to the Everglades Forever Act to treat water discharged from the EAA.

**Improve Water Deliveries to the Everglades.** The volume, timing, and quality of water delivered to the South Florida ecosystem will be greatly improved. Compared to current conditions, an average of 26 percent more water will be delivered to Northeast Shark River Slough. This translates into nearly a half million ac-ft of additional water reaching the slough, which is especially critical in the dry season. More natural refinements will be made to the rain-driven operational plan to enhance the timing of water sent to the WCAs, Everglades National Park, and the Holey Land and Rotenberger Wildlife Management Areas (WMAs).

**Remove Barriers to Sheetflow.** More than 240 miles of project canals and internal levees within the Everglades will be removed to reestablish the natural sheetflow

of water through the Everglades. Most of the Miami Canal in WCA-3 will be removed and 20 miles of the Tamiami Trail (U.S. 41) will be rebuilt with bridges and culverts, allowing water to flow more naturally into Everglades National Park, as it once did. In the Big Cypress National Preserve, a north-south levee will be removed to restore more natural overland water flow.

**Store Water in Existing Quarries.** Two limestone quarries in northern Miami-Dade County will be converted to water storage reservoirs to supply Florida Bay, the Everglades, Biscayne Bay, and Miami-Dade County residents with water. The 11,000-acre area, which is referred to as the Lake Belt, will be ringed with seepage barriers to ensure that stored water does not leak or adjacent ground water does not seep into the area. A similar facility will be constructed in northern Palm Beach County.

**Reuse Wastewater.** Two advanced wastewater treatment plants are planned for Miami-Dade County. These plants will be capable of making more than 220 million gallons a day (MGD) of the county's treated wastewater clean enough to discharge into wetlands along Biscayne Bay and for recharging the Biscayne Aquifer. This reuse of water will improve water supplies to south Miami-Dade County and reduce seepage from Northeast Shark River Slough. Given the high cost associated with using reuse to meet the ecological goals and objectives for Biscayne Bay, other potential sources of water to provide freshwater flows to the central and southern bay will be also investigated.

**Pilot Projects.** A number of technologies proposed in the Restudy have uncertainties associated with them. Uncertainties exist in either the technology itself, its application, or the scale of implementation. While none of the proposed technologies are untested, what is not known is whether actual performance will measure up to that anticipated in the Restudy. The pilot projects, which include reuse of reclaimed water, seepage management, Lake Belt technology, and three ASR projects are recommended to address uncertainties prior to full implementation of these components.

**Improve Freshwater Flows to Florida Bay.** Improved water deliveries to Shark River Slough, Taylor Slough, and wetlands to the east of Everglades National Park will in turn provide improved deliveries of freshwater flows to Florida Bay. A feasibility study is also recommended to evaluate additional environmental restoration needs in Florida Bay and the Florida Keys.

**Southwest Florida Feasibility Study.** Additional water resource problems in Southwest Florida require studies beyond the scope of the CERP. In this regard, a feasibility study for Southwest Florida is being recommended to investigate the region's hydrologic and ecological restoration needs.

**Comprehensive Integrated Water Quality Plan.** A comprehensive water quality plan needs to be developed to ensure that the implementation of the CERP leads to ecosystem restoration throughout South Florida. The water quality feasibility study needs to be conducted to develop this plan. The feasibility study would include evaluating water quality standards and criteria from an ecosystem restoration perspective and developing recommendations to integrate existing and future water quality restoration targets for

South Florida water bodies into future planning, design, and construction activities to facilitate implementation of the CERP. Further, water quality in the Florida Keys is critical to ecosystem restoration. The Florida Keys Water Quality Protection Plan includes measures for improving wastewater and storm water treatment within the Florida Keys.

A summary of CERP components, areas they benefit, total cost, and timelines for the projects are presented in **Figure 35**. Specific details for each component, including their location, can be found in **Appendix C**.

When looking at alternatives beyond the 2020 Base Case, the LEC Plan included the planned implementation of the CERP. In the simulation of the alternatives, the initial alternative incorporated the CERP components and was called the LEC 2020 with Restudy. The other alternatives, LEC-1 and LEC-1 Revised, also included the CERP components. One of the goals of the alternatives' evaluations was to determine the extent to which the expected CERP projects will provide the water resource development needed to meet the goals of the LEC Plan. The conclusion reached in **Chapter 4** was that the CERP projects scheduled to be completed by 2020, along with the assumed level of wellfield development, provide the needed water resources to achieve the LEC Plan planning goal of providing users with adequate water supplies during a 1-in-10 year drought. Thus, implementation of the CERP is the major water resource development component proposed by the LEC Plan.

The major focus of evaluations of CERP components within the LEC Plan was their aggregate performance in meeting water supply and environmental performance goals. These results were discussed in **Chapter 4**. The amount of water provided by each of the components will be identified. This amount of water can be considered at two levels, the overall water capacity the component and the amount delivered under specific water supply conditions. **Table 53** presents information on those CERP components for which a specific water supply capacity can be attributed. **Table 54** presents results from the SFWMM simulation with the best performance, the LEC-1 Revised simulation, showing the amounts of water provided by key CERP features on an average annual basis during the 31-year simulation and during five drought years. **Table 55** presents similar information from the viewpoint of the demand area, listing the amounts of water delivered to each demand area from each relevant component.

During the modeling and evaluations performed for the LEC regional water supply planning process, further improvements to the CERP performance and cost-effectiveness have been identified. These recommendations are discussed later in this chapter (see the **Recommendations to the CERP from the LEC Plan** section) and in **Chapter 6**.

| Task Name | Rec | Benefit | Start | Finish |
|---|---|---|---|---|
| Lake Okeechobee ASR Pilot | 17 | Feasibility | Thu 7/1/99 | Wed 6/23/04 |
| Caloosahatchee River ASR Pilot | 17,28 | Feasibility | Wed 11/1/00 | Tue 10/25/05 |
| Lakebelt Technology Pilot | 17 | Feasibility | Thu 7/1/99 | Wed 12/14/11 |
| Reuse Technology Pilot | 17 | Feasibility | Fri 10/1/99 | Thu 9/20/07 |
| Seepage Management Pilot | 17 | Feasibility | Wed 11/1/00 | Tue 10/28/03 |
| Hillsboro (Site 1) ASR Pilot | 5,17 | Feasibility | Thu 7/1/99 | Fri 11/1/02 |
| Lake Okeechobee ASR | 17 | Quantity, Timing | Thu 6/24/04 | Wed 6/17/20 |
| Lake Okee Water Quality Treatment | 17 | Qnty,Qlty,Tmg,Spat Ext | Mon 10/1/01 | Fri 9/17/10 |
| North of Lake Okeechobee Storage | 17 | Quantity, Quality, Timing | Mon 10/3/05 | Fri 9/18/15 |
| C-43 Basin Storage Reservoir and ASR | 17,29 | Quantity, Quality, Timing | Thu 6/1/00 | Thu 3/22/12 |
| Caloosahatchee Backpumping/STA | 17 | Quantity, Quality, Timing | Mon 10/3/05 | Fri 9/18/15 |
| L-8 Project | 17,21 | Quantity, Quality, Timing | Mon 9/27/04 | Fri 9/16/11 |
| Lake Okee Tributary Sediment Dred | 17 | Quality | Tue 10/2/01 | Mon 9/26/05 |
| Taylor Ck/Nubbin Slough Storage/STA | 17 | Quantity, Quality, Timing | Mon 1/31/00 | Fri 1/16/09 |
| EAA Storage Reservoirs | 17,20 | Quantity, Quality, Timing | Thu 7/1/99 | Fri 12/25/15 |
| C-17 Backpumping and Treatment | 17 | Quantity, Quality, Timing | Mon 11/4/02 | Fri 10/24/08 |
| Pal Mar/Corbett Hydropattern Rest | 17 | Distribution, Spatial Extent | Mon 10/1/01 | Fri 9/22/06 |
| C-51 and Southern L-8 Reservoir | 17 | Quantity, Quality, Timing | Mon 9/27/04 | Fri 9/12/14 |
| Hillsboro (Site 1) Impoundment/ASR | 17 | Quantity, Quality, Timing | Fri 9/28/01 | Fri 10/17/14 |
| Acme Basin B Discharge | 17 | Quantity, Quality, Timing | Mon 10/1/01 | Fri 9/22/06 |
| C-51 Backpumping and Treatment | 17, 18 | Quantity, Quality, Timing | Mon 11/4/02 | Fri 10/24/08 |
| C-51 Regional Ground Water ASR | 17, 22 | Quantity, Timing | Mon 9/27/04 | Fri 9/13/13 |
| Lake Worth Lagoon Restoration | 17 | Quality | Tue 10/4/05 | Mon 3/28/11 |
| Winsburg Farms Wetlands | 17 | Quantity, Quality, Timing | Mon 1/3/00 | Fri 12/23/05 |
| Prot. Wetlands Near WCA-1 (Strazulla) | 17 | Spatial Extent | Fri 9/28/01 | Fri 10/26/07 |

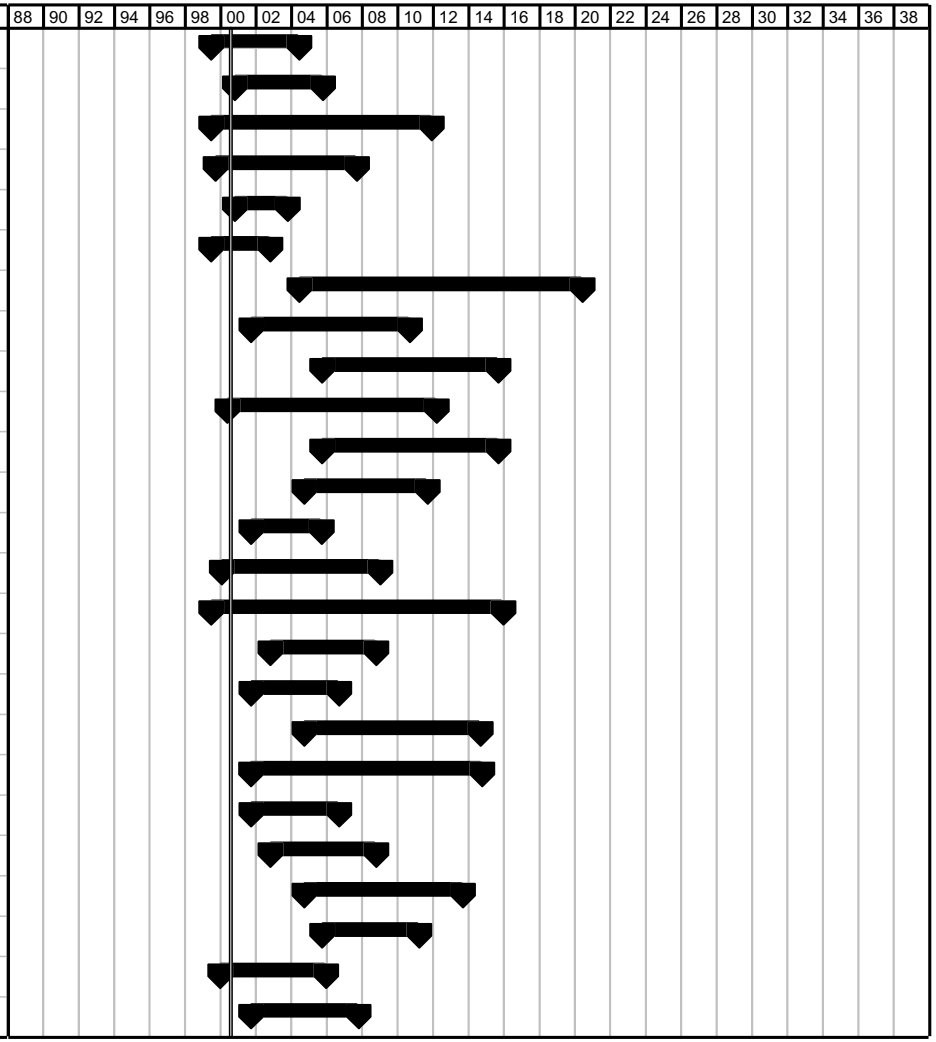


**Figure 35.** A Summary of CERP Components, Total Costs, Areas They Benefit and Timelines for the Projects.

| Task Name | Rec | Benefit | Start | Finish |
|---|---|---|---|---|
| PBC Ag Reserve Reservoir/STA | 17 | Quantity, Quality, Timing | Thu 9/1/05 | Wed 8/21/13 |
| Western C-11 Diversion | 17 | Quantity, Quality, Timing | Mon 10/1/01 | Fri 9/19/08 |
| C-9 STA/Impoundment | 17 | Quantity, Quality, Timing | Mon 10/1/01 | Fri 9/21/07 |
| Broward Secondary Canals | 17 | Distribution | Mon 7/2/01 | Fri 6/12/09 |
| North Lake Belt Storage Area (NLBSA) | 17,25 | Quantity, Quality, Timing | Mon 2/27/12 | Fri 6/20/36 |
| Central Lakebelt Storage Area (CLBSA) | 17,25 | Quantity, Quality, Timing | Mon 2/27/12 | Fri 12/19/36 |
| C-4 Control Structures | 17 | Quantity, Distribution | Mon 1/31/00 | Fri 7/22/05 |
| Pineland/Hardwood Restoration | 17 | Spatial Extent | Mon 10/2/00 | Fri 3/24/06 |
| Bird Drive Recharge Area | 17 | Quantity, Quality, Timing | Thu 1/1/04 | Wed 12/18/13 |
| L-31N Levee Improvement | 17 | Quantity, Distribution | Wed 10/30/02 | Tue 10/19/10 |
| Dade-Broward Levee/Pennsuco | 17 | Quantity, Distribution | Mon 10/1/01 | Fri 9/19/08 |
| C-111 Operations Mod | 17 | Timing | Wed 5/1/02 | Thu 4/1/04 |
| Reroute Miami Canal Wat Sup Deliv | 17 | Distribution | Mon 1/28/02 | Fri 1/16/09 |
| C-111N Spreader Canal | 17 | Distribution | Mon 1/31/00 | Fri 7/18/08 |
| South Miami-Dade County Reuse | 17 | Quantity, Quality, Distrib | Mon 7/4/11 | Fri 6/19/20 |
| West Miami-Dade County Reuse | 17,23 | Quantity, Quality, Distrib | Mon 7/4/11 | Fri 6/19/20 |
| WCA-1 Internal Structures | 17 | Distribution | Mon 1/31/00 | Fri 7/25/03 |
| Divert WCA-2 Flows to CLBSA | 17 | Distribution | Mon 4/1/02 | Fri 9/17/10 |
| WCA 3A and 3B Seepage Mgmt | 17 | Quantity, Distribution | Tue 10/2/01 | Mon 9/22/08 |
| Additional S-345 Structures | 17 | Distribution | Mon 1/28/02 | Fri 1/16/09 |
| Construction of S-356 Structures | 17 | Distribution | Mon 11/4/02 | Fri 10/26/07 |
| Decompartmentalize WCA-3 | 17 | Distribution | Mon 1/28/02 | Fri 1/4/19 |
| Flows to NW/Central WCA-3A | 17 | Distribution | Thu 11/2/00 | Wed 4/22/09 |
| Divert WCA-3 Flows to CLBSA | 17 | Distribution | Mon 4/1/02 | Fri 9/19/08 |
| Divert Flows from CLBSA to WCA-3B | 17 | Distribution | Mon 2/27/12 | Fri 2/17/17 |

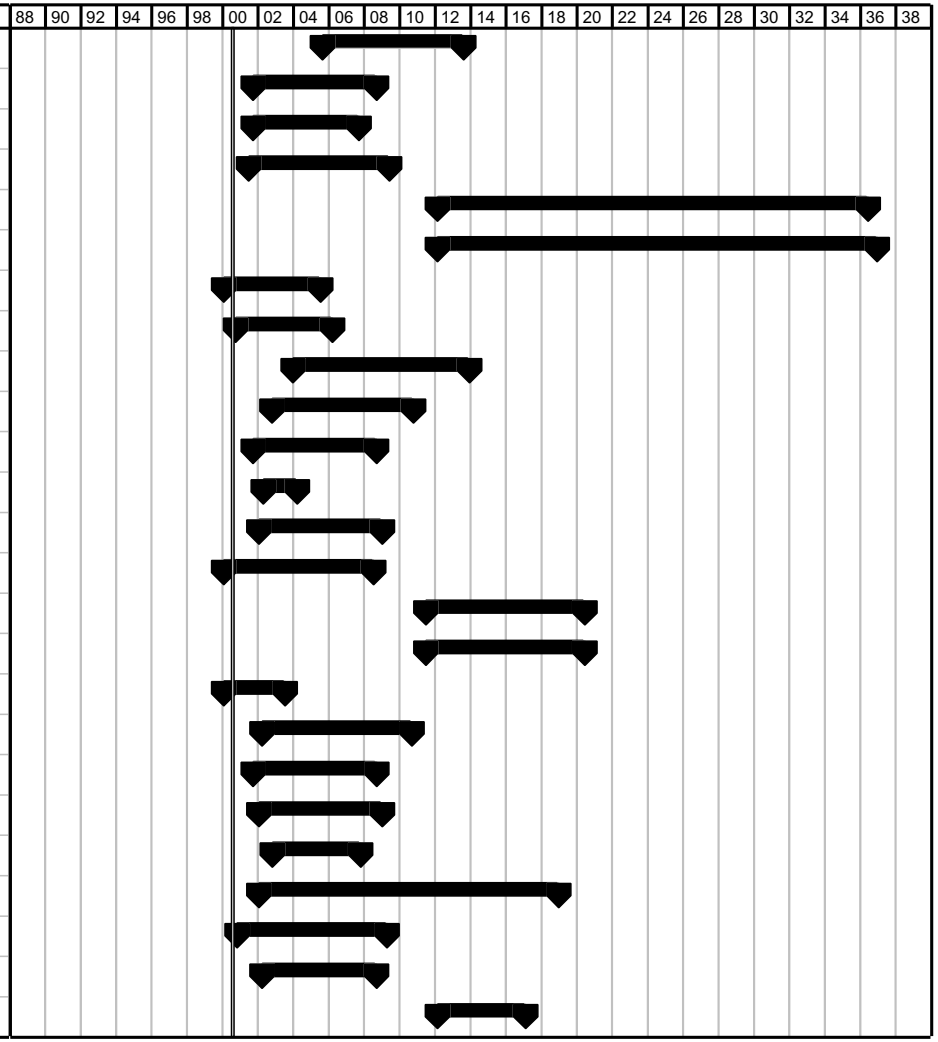


**Figure 35. (Continued)** Summary of CERP Components, Total Costs, Areas They Benefit and Timelines for the Projects.

| Task Name | Rec | Benefit | Start | Finish |
|---|---|---|---|---|
| G-404 Pump Station Modifications | 17 | Distribution | Wed 10/1/03 | Tue 3/24/09 |
| Biscayne Bay Coastal Wetlands | 17 | Distribution | Thu 4/20/00 | Wed 2/27/19 |
| Florida Keys Tidal Restoration | 17 | Distribution | Mon 3/6/00 | Fri 8/26/05 |
| Big Cypress/L-28 Interceptor | 17 | Quan, Qual, Timing, Distr | Mon 10/2/06 | Fri 9/16/16 |
| Miccosukee Water Mgmt Plan | 17 | Quantity, Quality, Timing | Mon 7/3/00 | Fri 12/19/08 |
| Seminole Water Conservation Plan | 17 | Quantity, Quality, Timing | Mon 1/1/01 | Fri 6/20/08 |
| Melaleuca/Exotic Plant Eradication | 17 | Exotic Plant Control | Mon 10/2/06 | Fri 9/23/11 |
| SW Florida Study | 17,30 | Feasibility | Thu 4/1/99 | Wed 3/24/04 |
| Comprehensive Water Quality Plan | 17 | Feasibility | Fri 10/1/99 | Fri 12/22/06 |
| Florida Bay/Keys Feasibility Study | 17 | Feasibility | Fri 10/29/99 | Fri 10/22/04 |
| RECOVER | 17,20 | Adaptive Assessment | Thu 7/1/99 | Wed 12/22/38 |

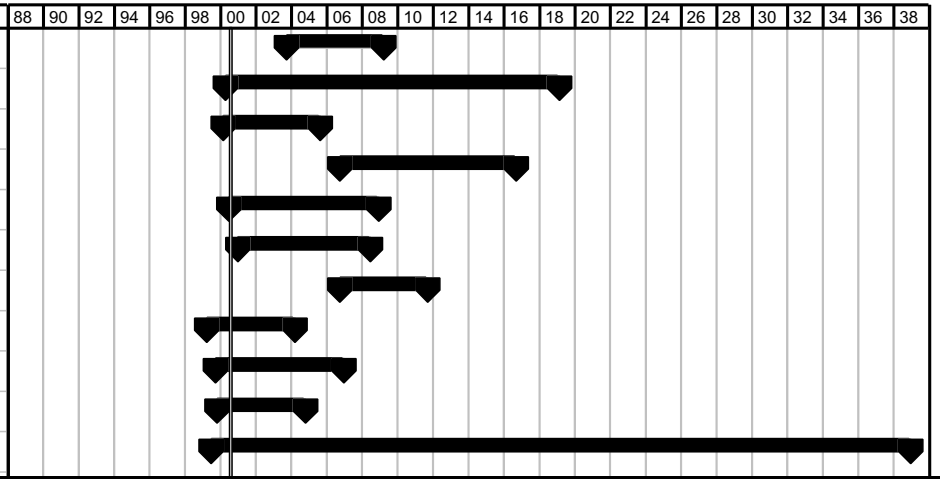


**Figure 35. (Continued)** Summary of CERP Components, Total Costs, Areas They Benefit and Timelines for the Projects.

**Table 53.** Minimum and Maximum Water Capacity of Major CERP Components.

| Component | Water Capacity | |
|---|---|---|
| | Minimum | Maximum |
| Lake Okeechobee ASR | 1K MGD ASR | 1K MGD ASR |
| North of Lake Okeechobee Storage Reservoir | 100K ac-ft | 200K ac-ft |
| C-44 Basin Storage Reservoir | 20K ac-ft | 40K ac-ft |
| C-43 Basin Storage Reservoir with ASR | 80K ac-ft | 160K ac-ft reservoir<br>220 MGD ASR |
| L-8 Project | 25 MGD ASR | 50 MGD ASR<br>48K ac-ft reservoir |
| Taylor Creek/Nubbin Slough Storage Reservoir and STA | 50K ac-ft reservoir<br>20K ac-ft STA | 50K ac-ft reservoir<br>20K ac-ft STA |
| C-23/C-24/Northfork/Southfork Storage Reservoirs | 165K ac-ft | 192K ac-ft |
| EAA Storage Reservoirs | 240K ac-ft | 360K ac-ft |
| C-51 and Southern L-8 Reservoir | 120K ac-ft | 120K ac-ft |
| Hillsboro (Site 1) Impoundment | 10K ac-ft | 14.8K ac-ft |
| Hillsboro (Site 1) ASR | 220 MGD ASR | 370 MGD ASR |
| C-51 Regional Ground Water ASR | 340 MGD ASR | 540 MGD ASR |
| Palm Beach County Agricultural Reserve Reservoir and ASR | 10K ac-ft | 19.9K ac-ft reservoir<br>75 MGD ASR |
| Western C-11 Diversion Impoundment and Canal | 6.4K ac-ft | 6.4K ac-ft |
| C-9 STA and Impoundment | 10K ac-ft | 10K ac-ft |
| North Lake Belt Storage Area | 70K ac-ft | 90K ac-ft |
| Central Lake Belt Storage Area | 80K ac-ft | 187.2K ac-ft |
| Bird Drive Recharge Area | 11.5K ac-ft | 11.5K ac-ft |
| L-31N Levee Improvements for Seepage Management | 100 percent levee;<br>100 percent ground water | 100 percent levee;<br>100 percent wet season ground water |
| South Miami-Dade County Reuse | 131 MGD | 131 MGD |
| West Miami-Dade County Reuse | 100 MGD | 100 MGD |

**Table 54.** Average Annual Amounts of Water Provided by CERP Components.

| Component | Beneficiary | Average Annual Water Provided (1,000 ac-ft) | |
|---|---|---|---|
| | | LEC-1 Revised During the Simulation Period | During Drought Years[a] |
| C-44 Basin Storage Reservoir | C-44 Basin water supply | 1 | 1 |
| | St. Lucie Estuary | 8 | 0 |
| | Lake Okeechobee | 10 | 8 |
| North of Lake Okeechobee Storage Reservoir (recovery) | Entire system (via Lake Okeechobee) | 49 | 40 |
| Lake Okeechobee ASR (recovery) | Entire system (via Lake Okeechobee) | 115 | 256 |
| EAA Storage Reservoirs, Compartment 1 | EAA agricultural water supply | 204 | 168 |
| | EAA Storage Reservoirs, Compartment 2A | 20 | 26 |
| EAA Storage Reservoirs, Compartment 2A | EAA agricultural water supply | 6 | 2 |
| | WCAs and Everglades National Park | 122 | 42 |
| EAA Storage Reservoirs, Compartment 2B | WCAs and Everglades National Park | 110 | 8 |
| LEC Service Area (LECSA) 1 and North Palm Beach Service Area Reservoirs | LECSA 1 and North Palm Beach Service Area users | 10 | 13 |
| LECSA 1 and North Palm Beach Service Area ASR | LECSA 1 and North Palm Beach Service Area users | 51 | 76 |
| | EAA | 37 | 30 |
| LECSA 2 ASR | LECSA 2 users | 32 | 42 |
| North Lake Belt Storage Area | LECSA 3 water supply | 25 | 27 |
| | Biscayne Bay | 109 | 70 |
| Central Lake Belt Storage Area | WCAs and Everglades National Park | 59 | 75 |
| | Biscayne Bay | 27 | 8 |
| Bird Drive Recharge Area | LECSA 3 water supply | 15 | 19 |
| South Miami-Dade County Reuse | Biscayne Bay | 147 | 147 |
| West Miami-Dade County Reuse | Bird Drive Recharge Area | 56 | 56 |
| Construction of S-356 Structures and Relocation of a Portion of L-31N Borrow Canal | Biscayne Bay | 8 | 6 |

a. 1971, 1975, 1981, 1986, 1989

**Table 55.** Average Annual Basin-by-Basin Demands for the 31-Year Simulation Period and for Drought Years and How They Are Met.

| Demand Basin/ Water Body | Total Demand/Sources of Supply | Average Annual Water Provided (1,000 ac-ft) | |
|---|---|---|---|
| | | LEC-1 Revised During the Simulation Period | During Drought Years[a] |
| Caloosahatchee Basin (surface water demand) | Lake Okeechobee | 29 | 57 |
| | Local reservoir | Addressed by the CWMP | |
| | Caloosahatchee Basin ASR | | |
| | Local sources and rainfall | | |
| | Demand not met | | |
| St. Lucie Basin (surface water demand) | Lake Okeechobee | 25 | 48 |
| | St. Lucie Reservoir | 1 | 1 |
| | Demand not met | 1 | 5 |
| EAA | Lake Okeechobee | 85 | 205 |
| | EAA Storage Reservoirs | 209 | 170 |
| | LECSA 1 Regional ASR | 37 | 30 |
| | Local sources and rainfall | 905 | 832 |
| | Demand not met | 8 | 40 |
| LECSA 1 (to maintain coastal canals) | Lake Okeechobee | 3 | 11 |
| | WCAs | 32 | 75 |
| | LECSA 1 Reservoirs | 10 | 13 |
| | LECSA 1 Regional ASR | 51 | 76 |
| LECSA 2 (to maintain canals) | Lake Okeechobee | 9 | 27 |
| | WCAs | 8 | 15 |
| | LECSA 1 Regional ASR | 32 | 42 |
| LECSA 3 (to maintain canals) | Lake Okeechobee | 77 | 212 |
| | WCAs | 24 | 29 |
| | LECSA 3 Reservoirs | 40 | 46 |
| Caloosahatchee Estuary | Caloosahatchee Basin Reservoir | Addressed by the CWMP | |
| | Local basin runoff | | |
| | Lake Okeechobee (environmental) | 16 | 31 |
| | Lake Okeechobee (regulatory) | 28 | 0 |
| St. Lucie Estuary | C-44 Basin Storage Reservoir | 8 | 0 |
| | Local basin runoff[b] | 587 | 313 |
| | Lake Okeechobee (environmental) | 14 | 1 |
| | Lake Okeechobee (regulatory) | 12 | 0 |
| WCAs and Everglades National Park Rain-Driven Demands | Lake Okeechobee[c] | 193 | 222 |
| | EAA Storage Reservoirs | 232 | 50 |
| | EAA drainage to the south[d] | 662 | 536 |
| | Regulatory from Lake Okeechobee | 96 | 0 |
| Everglades National Park | NW Shark River Slough | 451 | 183 |
| | NE Shark River Slough | 685 | 306 |
| Biscayne Bay | Snake Creek (S29) | 114 | 81 |
| | Northern bay (G58, S28, and S27) | 145 | 111 |
| | Miami River (S26, S25B, and S25) | 60 | 33 |
| | Central bay (G97, S22, and S123) | 203 | 135 |
| | Southern bay (S21, S21A, S20, S20G, and S197) | 268 | 210 |

a. 1971, 1975, 1981, 1986, and 1989
b. Includes all contributing basins to the St. Lucie Estuary (C-23, C-24, North Fork, South Fork, and C-44)
c. Environmental releases from Lake Okeechobee to meet rain-driven demands
d. Includes flows from Holey Land and Rotenberger WMAs

## Recommendations to the CERP from the LEC Plan

As a result of the evaluations conducted in the development of both the LEC Plan and the CWMP, valuable insights have been developed regarding the potential design and operation of CERP projects. These insights should be incorporated into CERP planning and implementation efforts. The consideration of these insights is treated as a formal recommendation of the LEC Plan to the CERP.

The individual recommendations are further described and discussed in **Chapter 6**. They include the following:

- Additional analyses related to the implications of the planned location of S-155A on other CERP components need to be performed (**Recommendation 18**).
- The importance of identifying additional improvements for WCA-2B in CERP planning and RECOVER efforts was reiterated. WCA-2B was the only area of the northern Everglades that received an unacceptable score in LEC regional water supply planning and Restudy efforts to date (**Recommendation 19**).
- Changes are needed in the compartments proposed for the EAA reservoir to increase storage available to meet EAA demands and to increase utilization of the reservoir to meet demands in the West Palm Beach Canal Area of the EAA (**Recommendation 20**).
- The utilization of ASR water in the C-51 Canal, West Palm Beach Catchment Area, and Hillsboro systems needs to be increased above the uses achieved in Restudy evaluations. Use of the C-51 Canal and West Palm Beach Catchment Area water to meet demands in the EAA is suggested. Use of Hillsboro ASR water to meet demands in LECSA 2 is recommended (**Recommendations 21** and **22**).
- Consideration of different capacities and uses of the West Miami-Dade Reuse system is recommended (**Recommendation 23**).
- Modifications of Lake Okeechobee Regulation schedules are recommended to achieve the best performance, given the structural improvements that may be in place at various times during the plan implementation (**Recommendation 24**).
- Implementation of the Lakebelt Storage Areas should begin as soon as possible (**Recommendation 25**).
- Early implementation of rain-driven schedules for the WCAs and Everglades National Park is recommended (**Recommendation 26**).
- Future CERP planning efforts need to consider wellfield configurations and performance evaluated in the LEC Plan, as

well as subsequent consumptive use permitting actions (**Recommendation 27**).

## Recommendations to the CERP from the CWMP

The following recommendations from the CWMP are included here because they will provide insight into the implementation of the CERP:

- Confirmation of the advisability of completing the Caloosahatchee ASR Pilot Project (**Recommendation 28**)
- The C-43 Storage Project (**Recommendation 29**)
- The Southwest Florida Study (**Recommendation 30**).

## Operational Recommendations

Operational improvements and reevaluations are included in the CERP which call for the development of rain-driven environmental delivery formulas and the revision of operating procedures and protocols to reflect the completion of new facilities. The LEC Plan has identified three additional areas for improvements to operations that are needed for the next five to 10 years until the CERP features begin to come on-line.

### Systemwide Operational Protocols (Recommendation 31)

The incremental simulations completed as part of the LEC Plan indicated that the frequency and severity of low lake levels under the 1965 to 1995 climatic conditions would cause water supply problems for users dependent on Lake Okeechobee through 2010. In this period, it is especially important that supply-side management policies be implemented in a flexible way to assure that the water in storage for each dry season is managed in the best way.

Lake Okeechobee supply-side management policy needs to be reevaluated to incorporate operational flexibility to improve water supply performance while taking into account environmental goals and conditions. One example would be the fact that over the last six years, extreme wet periods have kept the lake abnormally high for long periods of time. Under such conditions, a drawdown of the lake would provide ecological benefits.

### Periodic Operational Flexibility (Recommendation 32)

Operational priorities and protocols should be reevaluated on an annual basis and a specific strategy presented for Governing Board approval.

### Lake Okeechobee Vegetation Management Plan (Recommendation 33)

A Lake Okeechobee Vegetation Management Plan needs to be developed so that detrimental environmental effects from lower lake levels, primarily the spread of torpedo

grass and melaleuca, can be effectively managed. The program would then be implemented whenever lower lake levels dry the littoral zone.

## Consumptive Use Permitting and Resource Protection Projects

In this section, descriptions of the general implementation legal and policy guidances are provided for implementing reservations, MFL recovery and prevention strategies, consumptive use permitting, water shortage program, and operational strategies.

As one of the tools for plan implementation, rulemaking to implement the regulatory recommendations of the LEC Plan will constitute a significant effort during the next several years. Rulemaking will include water reservations and numerous Consumptive Use Permitting (CUP) criteria, which are interrelated and cumulatively define the availability of water for consumptive uses and water resource protection. As a result, it is recommended in the LEC Plan that certain rulemaking efforts be grouped in phases to allow for the cumulative analysis of the water resource and consumptive use implications of the regulatory program.

Another goal of the rulemaking schedule is to adopt rules as the technical information becomes available. As a result, it is recommended in this plan that initial rulemaking proceed for concepts that were sufficiently identified and evaluated in the planning process. These include establishment of MFLs for the Everglades, Lake Okeechobee, the Biscayne Aquifer, and the Caloosahatchee River.

In addition, uncertainties in the rulemaking process, such as delays for development of supporting technical data or rule challenges, may conflict with the proposed schedule for rule development provided in this plan. The proposed schedule will be adapted to account for such delays, while considering the need to develop associated rules through a coordinated rulemaking process. The contingency process identified in the plan, along with input from the LEC Regional Water Supply Plan Advisory Committee, other members of the public, and the Governing Board may be used to identify necessary changes to the rulemaking schedule.

### Water Reservations (Recommendation 34)

**Table 51** identifies the water bodies where reservations will be adopted, the basis upon which the reservations of water will be derived, and the targeted operation dates for water resource development projects that can provide the reservation water supplies. The basis upon which the reservations will be derived are rain-driven formulas, stage formulae, salinity envelope criteria, or Stormwater Treatment Area (STA) minimum depth of water.

These factors will be further refined through the reservation rulemaking and implementation process, including detailed design and feasibility analyses of associated water resource development projects. In addition to rule adoption of the reservations to set

aside water quantities from allocation, operational protocols will be developed to provide for phased increases in water quantities through 2020. Establishment of reservations are recommended for the following areas:

**Caloosahatchee and St. Lucie Estuaries.** Reservations for these water bodies will be established for the purpose of providing freshwater inflows to prevent harm. Optimal salinity profiles and corresponding quantities of freshwater inflows, particularly during the dry season, have been identified in technical publications and integrated into the LEC regional model targets. Water reservations will identify water quantities for meeting these targets, and will be applied when associated water resource development projects are constructed. Until the water resource development projects that will make water available for meeting these reservations are operational, the District will utilize an annual process to identify operational actions to optimize water deliveries based on the projected annual conditions to meet these targets. Final rule adoption is projected for the Caloosahatchee Estuary by 2000 and for the St. Lucie Estuary by 2001.

**Stormwater Treatment Areas.** Reservations for STAs will be adopted for the purpose of protecting fish and wildlife by maintaining water quality functions of the filter marsh and reducing the potential for nutrient releases associated with dry times. The reservation will include water quantities estimated to maintain at least 0.5 feet of water in the STAs to prevent dry out. Conditions on providing this water during droughts will also be identified, including conditions for making water deliveries from Lake Okeechobee with consideration given to other water supply needs of the regional system, consistent with operations in the *Everglades Construction Project Conceptual Design Document.* Final rule adoption is projected for 2001.

**Everglades National Park, the WCAs, and the Holey Land and Rotenberger WMAs.** Reservations will be adopted for the purposes of protecting fish and wildlife through restoration of hydropatterns as defined by the CERP for 2020. Model results in the LEC Plan indicate the water quantities that should be delivered to these areas based on the incremental increased water availability during the next 20 years through water resource development. The reservation rule will account for these interim incremental increases through time during the next 20 years. Estimates on water quantities to be made available under the reservation, water resource development projects, and operational protocol for providing these water quantities will be identified in the rule. Final rule adoption is projected for 2003.

**Subregional Wetland Restorations.** Reservations will be adopted, where appropriate, for the purpose of protecting fish and wildlife in urban wetland systems slated for enhancement (Loxahatchee Slough, Pond Apple Slough, Fern Forest, Trade Winds Park, Model Lands, Pennsuco Wetlands, South Dade Wetlands, etc.). The District will work with Palm Beach, Broward, and Miami-Dade counties to quantify the reservations and identify the sources of water, when appropriate. Final rule adoption is projected for 2003.

**Biscayne Bay, Florida Bay, and the Loxahatchee River.** Reservations will be adopted for the purpose of protecting fish and wildlife through providing

freshwater inflows that prevent harm. The Loxahatchee River Reservation Rule will be adopted by December 2001. Research on the freshwater inflows to Florida Bay is scheduled to be completed by December 2002. Final rule adoption is projected for Florida Bay by 2003 and for Biscayne Bay by 2004.

**Lake Okeechobee.** Lake Okeechobee provides water storage for multiple purposes including consumptive uses of water and a number of water resource protection purposes. It will store and provide water for several reservations including the Everglades, the STAs, the Biscayne aquifer, and the St. Lucie and Caloosahatchee estuaries. However, the lake has its own demand for water supplies to protect fish and wildlife. Therefore, the management of the lake must address its function as a natural system, as well as a water supply source. At the time of completion of this plan, a reservation proposed for the lake had not yet been quantified. It is recommended that the protection of the lake's fish and wildlife be considered and the lake reservation developed in concert with the reservations for the water bodies that rely on the lake.

Following required research to support adoption of reservations for these areas, the District will proceed with identification of operational, regulatory, and water resource development projects necessary to implement the reservations. This will also include integration of the reservations and implementation actions into regional water supply plan updates, five-year water resource development plans, and annual budgets.

### Establish MFLs (Recommendation 35)

Eight water bodies located within the LEC planning area have been identified as priority water bodies within the DWMP for the establishment of MFLs. The establishment of MFLs for four of these water bodies (Lake Okeechobee, the Everglades and the WCAs, Biscayne aquifer, and the Caloosahatchee River) is scheduled for completion in 2000. For detailed descriptions of the basis for Lake Okeechobee, the Everglades, and Biscayne Aquifer MFLs refer to *Minimum Flows and Levels for Lake Okeechobee, the Everglades, and the Biscayne Aquifer* (SFWMD, 2000e). The documentation of the Caloosahatchee River MFLs is not yet complete. The recommended MFL criteria for each of these four water bodies used in the evaluation phase of the LEC Plan are listed below. These recommended MFLs will undergo rulemaking later this year.

#### Lake Okeechobee

Water levels should not fall below 11 ft NGVD for more than 80 days duration, more often than once every six years, on average (SFWMD, 2000e).

#### Peat-Forming Wetlands in the Everglades and the WCAs

Water levels within wetlands overlying organic peat soils within the WCAs, Rotenberger and Holey Land WMAs, and Shark River Slough (Everglades National Park) shall not fall below ground surface for more than 30 days and shall not fall below 1.0 foot below ground for one day or more of that 30-day period, at specific return frequencies for different areas, as identified in **Table 44** in **Chapter 4**.

### Marl-Forming Wetlands in the Everglades and the WCAs

Water levels within marl-forming wetlands that are located east and west of Shark River Slough, the Rocky Glades, and Taylor Slough within Everglades National Park, shall not fall below ground surface for more than 90 days and shall not fall below 1.5 feet below ground for one day or more of that 90-day period at specific return frequencies for different areas, as identified in **Table 44** in **Chapter 4**.

### Biscayne Aquifer

The term minimum water level for the Biscayne aquifer refers to water levels associated with movement of the saltwater interface landward to the extent that ground water quality at the withdrawal point is insufficient to serve as a water supply source for a period of several years before recovering. For evaluation of model simulations, operational criteria are applied to the coastal canals that receive regional water. **Table 6** in **Chapter 4** provides the minimum canal operational levels for eleven primary water management structures. To meet the operational criteria, the canal stage cannot fall below the criteria for more than 180 days, and the average annual stage must be sufficient to recover after a drought or discharge event.

### Caloosahatchee Estuary

The freshwater inflow associated with preventing harm or significant harm is an average of 300 cfs per day at the S-79 structure during the months of November through March. The determination of this inflow is discussed in **Chapter 4** on **page 92**.

### Additional MFLs

MFLs will be established for five additional water bodies: the Loxahatchee River, the St. Lucie Estuary, Florida Bay, Biscayne Bay, and the southern Biscayne aquifer in 2001, 2001, 2003, 2004, and 2003, respectively. Since the research necessary to define the MFLs and restoration targets for each of these water bodies has not been completed, estimates were used as discussed below for evaluating performance measures for this plan. These estimates will be replaced with the actual MFLs during the next five-year LEC Plan update. Options for recovery and prevention strategies will be explored and incorporated into future plan updates.

## MFL Criteria for the Rockland Marl Marsh (Recommendation 36)

The majority of plant and animal communities that exist within the remaining Rockland marl marsh, located within and adjacent to Everglades National Park, have been severely impacted by overdrainage and development east of the park. Studies of remaining communities have provided some limited information concerning the appropriate depth and duration of water levels needed to sustain their characteristic vegetation and wildlife communities. Current MFL targets proposed for this area are based on management targets developed as part of the Restudy/CERP and LEC regional water supply planning processes which are based on output of the Natural System Model (NSM).

It is the expert opinion of Everglades National Park staff that the NSM does not properly simulate hydrologic conditions within the Rockland marl marsh and that the interim MFL criteria may not sufficiently protect these wetlands from significant harm. Additional research is required to determine an appropriate return frequency for drought conditions that can be tolerated by both plant and animal populations without causing significant harm to their structure and function. Research on short hydroperiod, marl-forming wetland plant and animal communities is needed to determine the following: the distribution, extent, and structure of these communities within the historic Everglades; their historic and potential future role and significance as sources of food for wading birds and other vertebrates; and the seasonal dynamics of fish and macroinvertebrate populations, especially the amount of time that sustained high water levels are required to maintain ecosystem aquatic productivity.

As part of the LEC water supply planning process, staff from the District, Everglades National Park, and U.S. Geological Survey (USGS) should jointly develop a work plan to conduct the necessary research needed to validate and/or refine the proposed MFL criteria, especially the return frequency component, for the Rockland marl marsh.

### MFLs for Florida Bay (Recommendation 37)

Findings of the MFL Scientific Peer Review Panel (Jordan, et al., 1998) recommended that a sufficiency review be conducted to examine existing surface and ground water data, especially data that illustrates the relationship between upstream water levels and flows and their impact on downstream estuary and bay salinity levels. Based on this review, the District and other stakeholders should determine appropriate time frames and mechanisms for the establishment of MFL criteria for Florida Bay.

In response to the above recommendation, and to requests made by Everglades National Park staff, Florida Bay was placed on the District's MFL Priority Water Body List for establishment in 2003. In addition, a formal MFL sufficiency review has been completed for Florida Bay and is currently under review by the Interagency Florida Bay Science Program and Everglades National Park staff. This sufficiency review presents an assessment of currently available technical information needed to develop MFL guidelines for Florida Bay. Florida Bay MFLs are defined as the minimum inputs of freshwater from the southern Everglades required to prevent significant harm to the Florida Bay ecosystem. Significant harm is defined as the loss of specific water resource functions that take multiple years to recover, which result from a change in surface water or ground water hydrology (SFWMD, 2000e).

Establishment of MFLs for Florida Bay is a challenging task because of the size, the spatial complexity of the estuary, and the diffuse nature of freshwater flow to the bay. The task requires an understanding of the physical and ecological characteristics of the bay and their sensitivity to fresh water inputs from the Everglades. By targeting a specific response variable (seagrass) that is critical to many other parts of the ecosystem (nutrient cycling, animals, other plants, water quality, etc.), the District expects to develop initial MFL technical criteria for Florida Bay by 2003. Conceptual models of Florida Bay are currently being developed by the CERP RECOVER team to identify some of the more

complex interactions within the ecosystem and may be used as a starting point to develop MFL criteria.

As future research efforts provide additional information on some of these more complex ecological processes, subsequent refinement of the initial MFL criteria may be necessary. A number of research efforts are already under way with a second phase to be completed by 2006. An integrated Interagency Florida Bay Science Program, in which the District participates, has been collecting ecological information on the bay for the past three years. The databases and computer models that are products of this ongoing program will provide a foundation for developing MFL technical criteria.

An ecologically based MFL determination should include the following considerations:

- Salinity is the dominant factor that is affected by changing freshwater flows and levels.
- Salinity is a naturally varying characteristic of estuaries and MFLs must have criteria that incorporate seasonal and interannual variability.
- Water quality components other than salinity are also affected by changes in freshwater flow.
- The effects of salinity are not only direct, such as physiological stress on plants and animals, but also indirect, such as changing nutrient cycles, plant community structure, habitat availability, reproduction, and food webs.
- MFL determination depends on both bay and upstream watershed responses to these changing conditions as these subsystems are interconnected.
- Defining significant harm to the Florida Bay ecosystem requires identification of the main processes that sustain the bay ecosystem and determination of the sensitivity of these processes to the establishment of MFL criteria.

A number of key data collection projects are currently underway, representing collaborations among federal, state, and university scientists. However, most of the interagency projects were not specifically designed for determination of MFL. Modifications of these projects, plus some additional research, will be needed to address specific MFL issues.

### MFL Recovery Strategies (Recommendation 38)

Pursuant to the requirements of the MFL statute, analyses of current and future conditions were conducted for each of the priority water bodies where MFLs were defined. When the evaluation showed MFLs are not or will not be met in the future, recovery or prevention strategies, as appropriate, were developed. Following are the MFL

recovery/prevention strategies for Lake Okeechobee and the Everglades. The evaluations showed that MFLs for the Biscayne aquifer are expected to be met and, therefore, a recovery/prevention strategy was not required.

### Lake Okeechobee

Analysis of the results of the 1995 and 2020 base cases show MFL criteria were met. As a result, the MFL criteria would probably not be exceeded even if the LEC Plan were not implemented. Therefore, a recovery plan is not required for Lake Okeechobee. The prevention strategy consists of implementation of the Water Shortage Plan, including supply-side management, as simulated in the LEC Plan.

### Caloosahatchee River and Estuary

Analyses of both the 1995 and 2020 base cases show the proposed MFL criteria for the Caloosahatchee Estuary would be exceeded. Therefore, a recovery plan is necessary. Evaluation of the model results show that while the Caloosahatchee Estuary MFL criteria was exceeded, sufficient quantities of water remained left in Lake Okeechobee to avoid significant harm to the Caloosahatchee Estuary until the proposed long-term regional storage facilities that comprise the recovery plan have been built. These regional storage facilities are recommended in LEC Plan and CWMP, including ASR and regional surface water reservoirs.

Long-term evaluations conducted for both the Restudy and the CWMP indicate that both MFL and minimum restoration flows (300 cfs during the fall and spring) can be met through a combination of the construction of reservoirs and limited deliveries from Lake Okeechobee and ASR systems located within the basin. Over the next five years, activities for construction of regional facilities include 1) implementation of the ASR pilot project, 2) development of the Project Implementation Report (PIR) for the C-43 Regional Surface Water Reservoir, and 3) completion of the Southwest Florida Study. The reservoir and ASR projects are scheduled for completion in 2010 and 2015, respectively (**Table 51**).

In the period of time prior to construction of these facilities, the District will utilize water in Lake Okeechobee, when available, for releases to the Caloosahatchee River to prevent MFL violations, which are projected to occur only during extreme droughts. In implementing this interim recovery and prevention strategy, releases to prevent significant harm will occur as follows: if a die back of *Vallisneria* grass beds occurs in the area identified in the MFL criteria during one year, for at least one of the following two years, an average of 300 cfs of water will be delivered at the S-79 structure during the months of February through April.

### The Everglades and Water Conservation Areas

Direct and indirect impacts can occur within the Everglades and WCAs that can be attributed to consumptive use withdrawals. Indirect impacts occur as a result of making regional water deliveries to areas other than the Everglades. Direct impacts result from the pumping of adjacent wellfields that lower the water table along the eastern edge of the

Everglades system, affecting wetlands located directly west of the north-south perimeter levee.

In an effort to define which areas of the Everglades may potentially be affected by existing and projected future water demands, District staff utilized the SFWMM to identify where the proposed MFL criteria were not met for the 1995 and 2020 base cases. Review of the 1995 Base Case showed the proposed Everglades MFL criteria were exceeded at 12 out of 19 locations (indicator regions) within the remaining Everglades system (**Table 45** in **Chapter 4**). Evaluation of the 2020 base case showed similar results (**Table 45** in **Chapter 4**), with no overall increase in the number of sites that exceeded proposed MFL criteria compared to the 1995 Base Case. These results indicate two things. First, a MFL recovery plan will be necessary for the 12 indicator regions identified in this modeling effort. Second, the instances in which the MFL criteria were exceeded were, for the most part, caused by drainage impacts associated with construction and operation of the Central and Southern Florida (C&SF) Project, while some areas may be influenced by a consumptive use withdrawal.

The next step taken was to conduct additional modeling to determine which areas of the Everglades may be affected by consumptive use withdrawals. The following preliminary screening analysis was conducted to identify these areas. The SFWMM simulated two scenarios using the assumptions in the LEC-1 simulation: 1) all LEC public water supply wellfields were turned on in the model, versus 2) all LEC public water supply wellfields were turned off in the model. These are referred to as the Pumps On and Pumps Off scenarios. Modeling results were evaluated using the set of environmental performance measures described in **Chapter 4** and **Appendix D** of this report and are similar to those used in the CERP evaluation process.

Results of the Pumps On and Pumps Off scenarios revealed five indicator regions within the Everglades system that were potentially susceptible to impacts from public water supply withdrawals, as shown in **Table 56**. With the wellfields turned off, improvements were observed in the number of times the MFL criteria were exceeded and the duration of the flooding, and a reduction was observed in the number of extreme low water events. These areas included 1) the Rockland marl marsh (11 percent difference in annual flooding); 2) eastern WCA-3B (six percent difference in annual flooding); 3) WCA-2B (five percent difference in annual flooding); 4) Northeast Shark River Slough (three percent difference in annual flooding), and 5) WCA-1, which showed an improvement in annual flooding (two percent), as well as significant reduction in the number of times the MFL criteria were exceeded. These preliminary results suggest that these five areas of the Everglades system have the potential to be impacted by water supply withdrawals to a limited degree.

Cutting off all public water supply wellfields was not considered practicable, due to the limited benefits to the regional system as projected in the model results balanced against 1) the cost of source replacement, 2) the potential water resource impact of large-scale Floridan aquifer development necessary to replace surficial supplies, and 3) long time frames required to develop such sources. These factors were also considered against the fact that the CERP planning process has already provided consensus based alternatives

**Table 56.** Summary of the LEC Water Utility Pumps On and Pumps Off Scenarios for Selected Everglades Sites[a] for the 2020 Base Case.

| Area | Gage | IR[b] | Number of Times MFL Criteria Were Exceeded[c] | Inundation/Duration Summary[c] | | | Number of Extreme Low Water Events[c] |
|---|---|---|---|---|---|---|---|
| | | | | Number of Flooding Events[c] | Duration (weeks)[c] | Percent Increase in Annual Flooding[c] | |
| Loxahatchee National Wildlife Refuge (WCA-1) | 1-7 | 27 | 7/1 | 20/18 | 74/84 | 92/94 (2%) | 5/1 |
| WCA-2A | 2A-17 | 24 | 8/7 | 18/16 | 80/92 | 90/92 (2%) | 8/9 |
| WCA-2B | central | 23 | 7/6 | 15/14 | 93/104 | 86/91 (5%) | 8/6 |
| Holey Land WMA | HoleyG | 29 | 5/5 | 11/11 | 140/140 | 96/96 | 5/5 |
| Rotenberger WMA | Rotts | 28 | 22/22 | 38/38 | 34/34 | 79/79 | 20/20 |
| Northwest corner of WCA-3A | 3A-NW | 22 | 10/8 | 22/21 | 68/72 | 92/94 (2%) | 8/6 |
| Northwestern WCA-3A | 3A-2 | 20 | 11/11 | 27/25 | 52/57 | 87/88 (1%) | 10/8 |
| Northeastern corner of WCA-3A | 3A-3 | 68 | 10/8 | 19/17 | 76/85 | 90/90 | 8/8 |
| Northeastern WCA-3A | 3A-NE | 21 | 8/7 | 17/15 | 88/101 | 92/94 (2%) | 9/8 |
| Central WCA-3A | 3A-4 | 17 | 10/10 | 25/24 | 57/59 | 88/88 | 9/9 |
| Southern WCA-3A | 3A-28 | 14 | 8/7 | 17/18 | 88/83 | 93/93 | 5/7 |
| WCA-3B | 3B-SE | 16 | 15/11 | 29/20 | 46/72 | 83/89 (6%) | 19/12 |
| Northeastern Shark River Slough | NESRS-2 | 11 | 9/7 | 20/18 | 71/82 | 88/91 (3%) | 9/10 |
| Central Shark River Slough | NP-33 | 10 | 7/7 | 15/13 | 100/117 | 93/94 (1) | 7/8 |
| Southwestern Shark River Slough | NP-36 | 9 | 8/6 | 15/15 | 98/100 | 91/93 (2) | 11/9 |
| Marl wetlands east of Shark River Slough | NP-38 | 70 | 15/13 | 61/61 | 15/16 | 58/59 (1%) | NA[d] |
| Marl wetlands west of Shark River Slough | NP-201 | 12 | 9/8 | 36/31 | 36/43 | 80/82 (2) | 20/20 |
| Rockland Marl Marsh | G-1502 | 8 | 24/19 | 40/40 | 19/23 | 46/57 (11%) | 31/25 |
| Taylor Slough | NP-67 | 1 | 16/16 | 38/36 | 30/32 | 71/72 | 28/28 |

a. Sites selected based on their potential for impact by a LEC wellfield withdrawal
b. IR = Indicator Region
c. First number in each box represents utility **Pumps On (full water use)**; second number represents **Pumps Off (a 30% cutback in water use by Miami-Dade County)**
d. NA = Not applicable

to meet the recovery goals of South Florida's natural systems. For these reasons, staff proceeded to model a more realistic consumptive use withdrawal scenario that incorporates assumptions based on the District's current water shortage policy.

This modeling effort was basically a sensitivity analysis to identify the relative magnitude of impact that a 30 percent cutback in public water supply might have on the five areas identified above. The sensitivity analysis was conducted with the SFWMM simulating 1) all LEC public water utilities pumps turned on; and 2) all LEC utilities turned on, with Miami-Dade County's wellfields reduced by 30 percent (the level of cutback associated with Phase II water shortage restrictions).

The purpose of this analysis was to see if simply implementing a water shortage cutback could reduce the number of times the MFL criteria was exceeded prior to the construction of the CERP projects. Modeling results were evaluated using the standard set of environmental performance measures developed for the LEC Plan (**Chapter 4** and **Appendix D**). These included review of 1) the number of times the MFL criteria were exceeded during the 31-year simulation period, 2) stage hydrographs and stage duration curves, 3) the number of flooding events and their duration, 4) the percent reduction or increase in annual flooding, and 5) the number of extreme high and low water events.

**2005 Incremental Simulation with a 30 Percent Cutback.** For the 2005 incremental simulation, three areas were identified that showed hydrologic differences between the two modeling scenarios. These areas were 1) the Rockland marl marsh located with Everglades National Park (Indicator Region 8), 2) Northeast Shark River Slough (Indicator Region 11), also located in Everglades National Park, and 3) southeast WCA-3B (Indicator Region 16). All three of these sites are located within the extreme western portion of urbanized Miami-Dade County (**Table 57**). The impacts of the 30 percent cutback to the other two areas were not measurable.

**Table 57.** Results of the Model Simulation for Selected Everglades Sites[a]: 2005 versus 2005 with a 30 Percent Cutback in Public Water Supply Withdrawals for Miami-Dade County.

| Area | IR[b] | Number of Times MFL Criterion Was Exceeded[c] | Inundation/Duration Summary[c] | | | Number of High Water Events[c] | Number of Low Water Events[c] | Average Duration of Low Water Events[c] (weeks) |
|---|---|---|---|---|---|---|---|---|
| | | | Number of Flood Events[c] | Average Duration (weeks)[c] | Percent Change in Annual Flooding[c] | | | |
| Loxahatchee National Wildlife Refuge (WCA-1) | 27 | 5/5 | 21/21 (3) | 71/71 | 92/92 | 5/5 | 4/4 | 3/3 |
| WCA-2A | 24 | 14/14 | 23/23 | 60/60 | 86/86 | 0/0 | 16/16 | 5/5 |
| WCA-2B | 23 | 16/16 | 25/24 | 48/50 | 74/74 | 23/22 | 21/21 | 9/9 |
| Northwestern WCA-3A | 22 | 14/14 | 34/33 | 40/42 | 85/85 | 0/0 | 16/15 | 6/6 |
| Northeastern WCA-3A | 21 | 12/12 | 17/17 | 83/83 | 87/87 | 3/3 | 12/12 | 6/6 |
| Central WCA-3A | 17 | 8/8 | 17/17 | 88/88 | 93/93 | 5/5 | 8/7 | 4/4 |
| Southern WCA-3A | 14 | 1/2 | 10/8 | 158/198 | 98/98 | 19/17 | 1/0 | 1/0 |
| WCA 3-B | 16 | 10/10 | 21/19 | 68/76 | 88/90 (2%) | 5/5 | 13/12 | 4/3 |
| Northeastern Shark River Slough | 11 | 11/11 | 23/20 | 61/72 | 87/89 (2%) | 14/13 | 12/11 | 6/6 |
| Central Shark River Slough | 10 | 11/11 | 22/22 | 66/66 | 90/90 | 2/2 | 12/13 | 5/5 |
| Southwestern Shark River Slough | 9 | 10/10 | 20/21 | 71/68 | 89/89 | 0/0 | 16/16 | 4/4 |
| Rockland Marl Marsh | 8 | 21/20 | 35/37 | 27/26 | 58/60 (2%) | 0/0 | 26/27 | 13/12 |
| C-111 Perrine Marl Marsh | 4 | NA[d] | 81/79 | 10/10 | 49/50 (1%) | 0/0 | 43/48 | 34/30 |
| Mid-Perrine Marl Marsh | 3 | NA[d] | 48/48 | 18/18 | 52/53 (1%) | 0/0 | 31/28 | 4/4 |
| Taylor Slough | 1 | 16/16 | 38/38 | 30/30 | 71/72 (1%) | 1/1 | 27/27 | 4/4 |

a. Sites selected based on their potential for impact by a LEC wellfield withdrawal
b. IR = Indicator Region
c. First number in each box represents utility **Pumps On (full water use)**; second number represents **Pumps Off (a 30% cutback in water use by Miami-Dade County)**
d. NA = Not applicable

Review of stage hydrographs and stage duration curves for each of these three sites showed very minor differences in performance between the Pumps On and the 30 Percent Cutback modeling scenarios. Differences in performance between the two model simulations were small and included 1) a two percent improvement in hydroperiod (annual flooding), 2) a small increase in the number of continuous flooding events, and 3) a decrease in the number of times the MFL criteria were exceeded for the Rockland marl marsh recorded under the 30 Percent Cutback scenario (**Table 57).** The improvements identified under the 30 Percent Cutback scenario are very close to or within the assumed confidence limits of the SFWMM and, therefore, may not be significant.

It should also be noted that this modeling scenario implements a 30 percent, year-round cutback for Miami-Dade County for the 31-year simulation. It is unlikely the District would impose a 30 percent cutback in public water supply for Miami-Dade County during wet periods or under normal rainfall conditions. The only time a 30 percent cutback would actually be in effect would be during a major drought period. Therefore, impacts or improvements to Everglades wetland hydrology observed under an actual 30 percent cutback scenario may be considerably less than those shown in **Table 57**.

**LEC-1 Revised Simulation with a 30 Percent Cutback.** By 2020, most of the CERP water supply and natural system restoration projects will be built and operating. Comparison of the Pumps On and the 30 Percent Cutback scenarios showed that only two areas have experienced hydrologic differences by 2020. These areas were 1) the Rockland marl marsh (Indicator Region 8) and mid-Perrine marl marsh (Indicator Region 3), each located within eastern portion of Everglades National Park (**Table 58**).

The largest difference recorded was within the Rockland marl marsh where a three percent improvement in hydroperiod (average annual flooding) was observed under the 30 Percent Cutback scenario (**Table 58**). In addition, a small decrease in the number of MFL criteria violations for the Rockland marl marsh was observed under the 30 Percent Cutback scenario. In the mid-Perrine marl marsh, a two percent improvement in hydroperiod and a small increase in the number of continuous flooding events was observed when the 30 percent cutback was imposed (**Table 58**). Again, these results are close to the confidence limits of the SFWMM. It is unlikely the District would impose a 30 percent year-round cutback in public water supply for Miami-Dade County. Therefore, the observed differences between model simulations would more than likely be less than those presented in **Table 58**.

These cutbacks did not show a significant reduction in the number of times the MFL criteria were exceeded, suggesting that a 30 percent cutback would not be effective in improving the MFL performance in the Everglades. As a result, the recommended MFL recovery program for the Everglades does not incorporate cutbacks of consumptive use permits.

The District's current CUP criteria prohibits the issuance of permits that would cause harm to the water resources. As a result, in areas where the MFL criteria are being exceeded (significant harm occurring), no consumptive use permits could be issued that would cause an additional drawdown under the 1-in-10 year level of certainty.

**Table 58.** Results of the Model Simulation for Selected Everglades Sites[a]: LEC-1 Revised versus LEC-1 Revised with a 30 Percent Cutback in Public Water Supply Withdrawals for Miami-Dade County.

| Area | IR[b] | Number of Times MFL Criterion Was Exceeded[c] | Inundation/Duration Summary[c] | | | Number of High Water Events[c] | Number of Low Water Events[c] | Average Duration of Low Water Events[c] (weeks) |
|---|---|---|---|---|---|---|---|---|
| | | | Number of Flood Events[c] | Average Duration[c] (weeks) | Percent Change in Annual Flooding[c] | | | |
| Loxahatchee National Wildlife Refuge (WCA-1) | 27 | 1/1 | 12/12 (3) | 129/129 | 96/96 | 7/7 | 1/1 | 1/1 |
| WCA-2A | 24 | 8/8 | 13/13 | 112/112 | 91/91 | 5/5 | 11/11 | 6/6 |
| WCA-2B | 23 | 8/8 | 19/18 | 71/75 | 83/84 (1%) | 21/22 | 12/12 | 8/7 |
| Northwestern WCA-3A | 22 | 6/5 | 27/20 | 56/76 | 94/95 (1%) | 0/0 | 4/4 | 4/3 |
| Northeastern WCA-3A | 21 | 15/14 | 26/26 | 52/52 | 83/84 (1%) | 7/7 | 17/19 | 5/4 |
| Central WCA-3A | 17 | 4/4 | 16/16 | 96/96 | 95/96 (1%) | 2/2 | 5/5 | 3/3 |
| Southern WCA-3A | 14 | 4/5 | 11/12 | 140/128 | 95/95 | 3/3 | 4/4 | 3/3 |
| WCA 3-B | 16 | 3/3 | 10/10 | 154/155 | 96/96 | 13/16 | 3/3 | 3/2 |
| Northeastern Shark River Slough. | 11 | 2/2 | 15/11 | 105/143 | 97/98 (1%) | 8/10 | 2/3 | 3/2 |
| Central Shark River Slough | 10 | 2/2 | 9/10 | 175/158 | 98/98 | 3/3 | 2/2 | 3/2 |
| Southwestern Shark River Slough | 9 | 4/4 | 15/13 | 103/119 | 96/96 | 0/0 | 6/5 | 2/2 |
| Rockland Marl Marsh | 8 | 22/20 | 38/39 | 23/24 | 55/58(3%) | 0/0 | 28/25 | 10/10 |
| C-111 Perrine Marl Marsh | 4 | NA[d] | 45/42 | 27/29 | 76/76 | 11/11 | 49/48 | 18/18 |
| Mid-Perrine Marl Marsh | 3 | NA[d] | 50/48 | 17/18 | 52/54 (2%) | 0/0 | 34/33 | 4/4 |
| Taylor Slough | 1 | 16/16 | 37/36 | 31/32 | 71/71 | 5/5 | 28/28 | 4/4 |

a. Sites selected based on their potential for impact by a LEC wellfield withdrawal
b. IR = Indicator Region
c. First number in each box represents utility **Pumps On (full water use)**; second number represents **Pumps Off (a 30% cutback in water use by Miami-Dade County)**
d. NA = Not applicable

Consumptive uses that would cause an increase in the number of times the MFL criteria were exceeded within the Everglades would also not be permittable.

As a result of these factors, the main component of the MFL recovery plan for the Everglades is the construction and operation of the CERP and LEC regional water supply planning projects slated for completion between 2010 and 2020. In the interim, the plan recommends that the District conduct an annual assessment of the availability of water supply in regional storage available for releases to prevent the MFL criteria from being exceeded. To the degree practicable, the District's Governing Board shall authorize staff to make releases to prevent violations of the proposed MFL criteria.

With regard to the CUP process, no new uses or increased withdrawals, notwithstanding seasonal withdrawals for ASR storage that do not impact MFL criteria, that directly cause additional drawdowns beneath areas where MFL criteria are not met, will be permitted prior to the implementation of water resource development projects for recovery of these areas. The District will initiate rulemaking to reserve from allocation

water intended for meeting hydropattern goals in the Everglades. These reservations will reflect initial limits on water availability in the regional system due to lack of storage, and will be revised or upgraded every five years, as needed, as CERP projects come on line. Finally, all CUP applicants will be required under District rule to demonstrate that their uses are efficient and consistent with the increase in water supplies as projects are implemented. To achieve this, the District will establish rules to further implement efficiency measures for use of water from the regional system, including criteria for capture of ASR water, and to limit by rule water allocations for new or increased cumulative demands from regional water supplies to five-year periods.

#### Biscayne Aquifer

Identified measures to prevent the MFL criteria from being exceeded for the Biscayne aquifer are as follows: 1) maintain coastal canal stages at the minimum operation levels shown in the MFL report; 2) implement CUP conditions for issuance to prevent harmful movement of saltwater intrusion up to a 1-in-10 year level of certainty; 3) maintain a ground water monitoring network and utilize data to initiate water shortage cutbacks should the threat of saline water movement become imminent; and 4) conduct research in high risk areas to identify where the position of the saltwater front is adjacent to existing and future potable water sources.

### MFL Monitoring Systems (Recommendations 39)

Monitoring systems must be established in order to implement MFL recovery and prevention strategies and conduct research necessary to further refine the ability to project when significant harm could occur. The monitoring systems will collect water flow, water level, and water quality data. Monitoring data is necessary to affect interim operational strategies and to gage the success of MFL long-term recovery and prevention strategies.

### Consumptive Use Permitting, Rulemaking, and Resource Protection Projects (Recommendations 40)

Specific rule provisions are necessary for implementation of the regulatory program, to be consistent with both the LEC Plan and localized resource protection standards. These are discussed below.

#### Level of Certainty

The level of assurance provided to consumptive users and the environment that water will be available to meet the reasonable demands up to specific hydrologic conditions must be defined by rule. The allocation methodologies and impact evaluations will be modified to reflect the 1-in-10 year level of certainty planning goal used in the water supply plan. For the purposes of determining allocation and evaluating the impacts of an allocation, the proposed rules will define 1-in-10 rainfall conditions across the entire district utilizing statistical methods and historic rainfall data (See **Proposed Methodology for Defining and Assessing the 1-in-10 Year Level of Certainty for the Lower East Coast Planning Area** in **Appendix I**).

## Permit Duration

Section 373.236 (1), F.S., Duration of Permits, states the following in relevant part:

> Permits shall be granted for a period of 20 years, if requested for that period of time, if there is sufficient data to provide reasonable assurance that the conditions for permit issuance will be met for the duration of the permit; otherwise permits may be issued for shorter durations which reflect the period for which such reasonable assurances can be provided.

The District will define by rule the conditions for issuance of 20-year permits and permits for lesser durations when sufficient information exists to provide reasonable assurances that the use will continue to meet the initial conditions for issuance, pursuant to Section 373.239, F.S., This will incorporate phased increases in allocations to meet increasing reasonable-beneficial uses incrementally, with implementation of water resource development projects as recommended in the LEC Plan.

A conceptual framework for implementing the permit duration statute has been set forth by District staff, and will be further refined in the rule development and rule making processes. Within this framework, two basic permit duration scenarios have been developed. The first scenario applies to permits for use of a source that will continue to be available for the planning horizon (20 years). The second scenario is for permits for use of sources where water availability depends upon future water resource development, including augmentation to meet current and increased user demands. Issuance of permits which fall into the second scenario will be determined as follows: a) the water quantity initially available (from 2000 through 2005) to meet initial demands of consumptive uses will be allocated for a 20-year period; and b) when additional water allocations from the source are requested to meet increasing demands, water that may become available through water resource development projects and other measures will be allocated in five-year increments. Permit modification will be required to receive allocation for these increased demands. These permits will extend for 20-year periods.

## Saltwater Intrusion Criteria

Hydrologic conditions under which harmful saline water intrusion will not occur as a result of cumulative existing and proposed consumptive use withdrawals during a 1-in-10 year drought need to be defined by rule. Existing water resource protection criteria for saltwater intrusion will remain and an additional method of analysis (flow vector analysis for net inflow during a 1-in-10 year drought) will be added. The vector analysis will be reflective of the evaluation conducted under the LEC Plan. In this process, the rules will be amended to require the applicant to measure the magnitude of ground water flow across the 250 milligrams per liter (mg/L) isochlor (saltwater-freshwater interface), assuming the maximum annual allocation withdrawal simulated during a 1-in-10 year drought event. For uses in which the net flow across the interface is either eastward or is zero for the drought event, the saltwater criteria will be met. Projects that produce a net westward flow of saline water will be denied.

## Wetlands and Other Surface Waters Protection

Numeric drawdown criteria for defining hydrologic conditions under which harm to the water resource functions to wetlands and other surface waters is projected to occur have been under development for the last several years. These criteria will be finalized for evaluation of the potential drawdown impacts of cumulative existing and proposed consumptive use withdrawals during a 1-in-10 year drought. Criteria differentiating wetland types according to hydrologic characteristics will also be proposed. Special factors for consideration in the hydrologic impact analysis, such as listed species utilization in wetland areas, will be incorporated into the rule. Requirements for avoidance and minimization of harmful consumptive use impacts will be identified. In addition, circumstances for use of mitigation to offset projected harmful impacts will be explored for inclusion in the rule, consistent with FDEP policy direction on this issue. Finally, public interest considerations for identifying circumstances when application of proposed wetland drawdown parameters would cause undue hardship, inconsistent with Section 373.223, F.S, Conditions for Permit Issuance, will be explored and considered for adoption, as appropriate.

## Permit Renewal Process

The timing of, and process for, the renewal of consumptive use permits must be identified. Staff contemplates that four years will be required to review all permits throughout the District, in the following order of planning areas: Upper East Coast, Lower West Coast, Lower East Coast, and Kissimmee Basin. In the interim period, public water supply permit durations will be linked to the date identified for renewal of irrigation permits.

## Regional Water Availability Criteria

The CUP program contains water resource rules must protect against harmful withdrawals, but does not analyze the regional cumulative impact of allocating water from the C&SF Project, as a source of either surface or ground water (induced seepage under the levees). Up to now, this approach was considered adequate for protecting the water resources from harm. However, now that MFL criteria and Everglades Protection Area restoration projects are being implemented, along with the potential for increasing human demands from the regional system, regional criteria must be developed to assess how much water is available for allocation and to meet environmental demands from the regional system.

The LEC preferred alternative (LEC-1 Revised) estimates the amounts of water available for each service area upon implementation of the LEC Plan over the next 20 years. The model evaluations conducted for the interim periods (2005, 2010, and 2015) define the incremental availability of water to each county (Palm Beach, Broward, and Miami-Dade) and for the upper and lower Indian Prairie/Istakpoga Basin from the regional system during 1-in-10 drought conditions (from ground water seepage and surface water flows, as appropriate).

## Improved Pasture Irrigation

Current allocation criteria for improved pasture irrigation are based on a volume of water needed to irrigate turf grass using a seepage irrigation method. The supplemental irrigation requirement in the existing *Basis of Review for Consumptive Use Permit Applications* (SFWMD, 1997d), is based on demands during a moderate drought condition, which would not be expected to occur once every five years. It is projected that the actual use of water for improved pasture is considerably below what this current allocation criteria allows. As a result, it is recommended that such criteria be revised to more accurately reflect actual irrigation practices and the amount of water necessary for pasture irrigation.

## Water Shortage Plan

The District will develop and adopt water shortage triggers to avoid causing significant harm to water resources, in conjunction with the implementation of the *Water Shortage Plan* (Chapter 40E-21, F.A.C.). Water shortage triggers to implement natural system protection and water supply source protection have been identified in the planning process and integrated into the LEC-1 and LEC-1 Revised simulations.

Resource protection criteria are designed to prevent harm to the resources up to an 1-in-10 year drought event. For drought conditions greater than an 1-in-10 year event, it may be necessary to decrease water withdrawals to avoid causing significant or serious harm to the resource. Water shortage triggers, or water levels at which phased restrictions will be declared, are used to curtail withdrawals by water use types and avoid water levels declining to a minimum level where significant harm to the resource could potentially occur.

Water shortage rule revisions will include language which addresses the conditions by which cutbacks to rainfall-based water reservations would be required during Phase I or Phase II water shortage restrictions. During Phase III or greater conditions, no restrictions to the rainfall delivery schedule in the reservation rule will be imposed, unless specifically ordered by the Governing Board, after consideration of the conditions on a case-by-case basis, in consultation with the public, and upon a finding of an overriding public interest.

Even though water shortage triggers will be established, a case-by-case analysis for a given drought circumstance will continue to exist. Thus, prior to declaring a water shortage, the District will also analyze the factors listed in the *Water Shortage Plan* concerning such issues as 1) whether or not sufficient water will be available to meet the estimated and anticipated user demands and 2) whether serious harm to the water resource will occur.

## Special Areas Designations

Two special area designations contained in the Water Use Permitting Program were reviewed based on the findings of this planning effort. Definitions of the designations and recommended changes, if any, are provided below.

**Reduced Threshold Areas.** Reduced Threshold Areas (RTAs) are areas of the District where the volume of usage delineating a general permit from an individual permit has been reduced from 100,000 gallons per day (GPD) to 10,000 GPD for average daily demand. RTAs have typically been designated in resource depleted areas that have an established history of substandard water quality, saline water movement, or the lack of water availability to meet the projected needs of a region. Results of the LEC Plan and increased impact analysis capabilities did not indicate significant potential problems. Assessment determinations are conducted for all consumptive use applications. For withdrawals less than 100,000 GPD, qualifying for a general permit versus an individual permit will be based on the potential cumulative impacts of the use.

**Water Resource Caution Areas.** Water Resource Caution Areas (WRCAs) were formerly referred to as Critical Water Supply Problem Areas and are described in Chapter 40E-23, F.A.C. WRCAs are defined as areas that have existing water resource problems or areas in which water resource problems are projected to develop over the next 20 years. Diversification of supply sources is currently occurring within some of these areas and it is anticipated these areas will change designation in the future once sufficient diversification has been realized. Water resource caution area boundaries will be redefined in the Lower West Coast (LWC) Planning Area pursuant to the results of the water supply plan analyses and evaluation. No changes in the boundaries in the LEC or Kissimmee planning areas are contemplated.

## Reuse of Reclaimed Water

Legislation enacted in 1994 requires all water management districts to adopt reclaimed water rules that address use of water from other sources in emergency situations or when reclaimed water is unavailable. These rules are to be adopted for the implementation in the upcoming permit renewal process. In addition, existing rules regarding reuse feasibility will be considered for adoption.

## Diversion and Impoundment

Allocation criteria for diversion and impoundment uses need to be identified. Criteria developed for allocation will consider efficiency in surface water delivery systems and recycling of water between crops. The allocation criteria will be primarily applicable to agricultural related systems.

## CUP Model Applications

Ground water computer models used for the LWC and LEC regional water supply planning processes need to be modified for application in determining individual impacts

of CUP applications. Rule changes identifying application of models in the CUP review process will be adopted, as appropriate.

#### Aquifer Storage and Recovery Permitting

Projects that involve diverting surface or ground water for storage underground in the Floridan Aquifer System must address the potential impacts of the use with regard to water resource protection and existing legal user protection. Prior to injecting the fresh water underground for storage, the applicant will be required to demonstrate that the fresh water stored will be protected from other users. Other users of the Floridan Aquifer System will seek assurances that the storage of fresh water and the resulting changes in the water chemistry and hydrostatic pressure within the aquifer will not be harmful to their proposed use. The ASR rule will address the impacts of initial diversion of water, the reasonable quantities necessary for the project, the impacts of injection on other existing legal users, the impacts of the withdrawals of water from storage in other existing legal user ASR projects, and interference caused by intermingling of water of differing water qualities on other uses. Criteria for the capture of water for storage during the wet times should be incorporated into the ASR allocation process through rulemaking.

#### BMP Makeup Water Rule Revisions

Previously, it had been estimated that the implementation of Best Management Practices (BMPs) in the EAA would reduce the volume of runoff available to be sent south into the Everglades by 20 percent. Since this rule was implemented in 1995, data collected and evaluated suggests that there is minimal reduction in runoff from the EAA due to BMP implementation. Therefore, it is recommended that the current BMP makeup water rule be revisited through a public rulemaking process to incorporate this new information

## Other Water Resource Projects

This section includes a water conservation program. Also, through the planning process, several evaluation and feasibility projects have been identified which will be completed and used in the formulation of the next update of the LEC Plan.

### Comprehensive Water Conservation Program (Recommendation 41)

Implementation of conservation measures by individual users is a water supply development activity, but these efforts need to be evaluated and supported as a water resource development project. Therefore, staff recommends establishing a comprehensive water conservation program. The program will both evaluate the implementation of existing conservation regulations and programs and conduct outreach to assure that all conservation opportunities are being implemented.

### Seawater Reverse Osmosis Treatment Facilities (Recommendation 42)

Recently, Tampa Bay Water approved a plant to obtain water from seawater by direct osmosis treatment. Proposed costs were significantly lower than other seawater desalination costs to date, and apparently reflect energy and disposal cost reductions due to the colocation of the plant with an existing coastal power plant. This project will evaluate the feasibility of colocating similarly designed plants at existing power plants in the LEC Planning Area. The feasibility studies will seek to determine the likelihood that the large cost reductions estimated for the Tampa plant are achievable. The District is initiating the feasibility study during the present fiscal year (2000).

Obtaining treated seawater much more cheaply than has previously been experienced has significant water resource development implications. Taking into account the savings in conventional water treatment costs, the use of seawater reverse osmosis treatment facilities may provide significant net savings compared to proposed CERP projects, such as the wastewater reuse facilities in Miami-Dade County, as a means to capture or provide additional water.

### Reclaimed Water System in Northern Palm Beach County (Recommendation 43)

This project will evaluate the feasibility of developing a regional irrigation water system for northern Palm Beach County and Martin County, utilizing reclaimed water from central Palm Beach County. Not only would this help meet future needs for irrigation water, but it would help recharge coastal aquifers, lessening saltwater intrusion threats, potential impacts on wetlands, and movement of existing pollutant plumes. It would also lessen the dependency of wastewater utilities on deep well disposal. The evaluation of this system will have to be coordinated with the CERP projects planned for this area.

### Indirect Aquifer Recharge (Recommendation 44)

Large amounts of secondarily treated wastewater are generated by wastewater utilities. While programs to promote and encourage reuse have been in effect for many years, the amount of reuse has remained small relative to the water potentially available. This project will examine ways in which reuse of reclaimed water can be increased while assuring that the reuse systems contribute to meeting water supply and environmental restoration goals that are commensurate with the additional costs that will be incurred.

Four facilities, which will produce reclaimed water (wastewater reuse) are included in the CERP process. The two largest projects are located in Miami-Dade County and together are expected to provide by 2020 about 200,000 ac-ft (230 MGD) of advanced treated water to recharge the coastal canals and aquifer in Miami-Dade County. The remaining two projects are located in Palm Beach County. The Palm Beach County Wetlands-Based Water Reclamation Project will take advanced treated water which will be further treated in a series of rehydrated marshes and eventually used to recharge wellfields and other areas. The Winsburg Farm Constructed Wetland, will use reclaimed

water to hydrate 175 acres of constructed wetlands. The efforts of the indirect aquifer recharge project will need to focus on issues not covered in these related CERP projects.

### High Volume Surface Water ASR Testing in Taylor Creek (Recommendation 45)

An opportunity may exist to utilize the District-owned ASR well located by Taylor Creek in Okeechobee County to test the practicality of using injection/recovery rates of 20 MGD into a prolific zone of the Floridan aquifer. Permit and well repair issues need to be resolved as part of this effort.

# WATER SUPPLY DEVELOPMENT OPTIONS

Water supply development options are discussed below in terms of the water sources on which they will rely. These sources are as follows:

- Conservation
- Ground Water (including the Biscayne/Surficial and the Floridan aquifer systems)
- Reclaimed Water
- Seawater Desalination
- Storage (including ASR and Reservoirs)
- Surface Water Sources

Water supply options which utilize each water source are discussed below with regard to their potential for use in the LEC Planning Area. For each option, the following information is presented: definition and discussion, estimated costs to develop that option and the quantity of water potentially available from that option, and conclusions regarding the potential of the water supply options which use each water source. This information is provided so that individual water users can better evaluate alternative water supply sources and select the alternative, or combination of alternatives, which best suit local conditions. That the water users conduct such an evaluation is the substance of **Recommendation 46** in **Chapter 6**.

## Conservation

### Definition and Discussion

This water supply option incorporates water conservation measures that address water demand reduction and capture of water that would otherwise be discharged to tide, including practices that achieve long-term permanent reductions in water use. Establishing a water conservation goal or conservation ethic was discussed by the LEC Regional Water Supply Plan Advisory Committee when goals and objectives were first considered for this plan. The following LEC Plan objectives were formed based on these discussions:

- Protect and conserve the water resources of South Florida to ensure their availability for future generations
- Provide for the equitable, orderly, cost-effective, and economical development of water supplies to meet South Florida's environmental, agricultural, urban, and industrial needs

The committee further discussed whether advanced levels of water conservation should be implemented beyond current mandatory requirements regardless of the cost, or whether advanced levels should be considered as a tool or source option to be evaluated with other source options to meet the water needs of a particular area.

## Mandatory Requirements

In 1988, The District began working with utilities to implement a conservation program through the CUP process. In 1991, the program was incorporated by rule and became part of the permitting process. The water conservation plans must incorporate specific elements depending on the type of use. For public water suppliers, the elements are an irrigation hours ordinance, a Xeriscape™ landscape ordinance, an ultra-low volume fixture ordinance, a rain sensor device ordinance, a water conservation-based rate structure, a leak detection and repair program, a public education program, and a reclaimed water feasibility evaluation. For commercial and industrial users the requirements include a water use audit, an employee water conservation awareness program, and implementation of cost-effective conservation measures. For landscape and golf course users the requirements are Xeriscape™ landscaping, the use of rain sensor devices, and irrigation hour limitations. For agricultural users, the requirement is that micro irrigation systems be used for new citrus and container nursery projects. In addition to these CUP requirements, conservation requirements are also incorporated in Recommended Orders for Developments of Regional Impact (DRI).

Depending on the demographics and location of the service area, utilities can choose to demonstrate which water conservation activities are more cost-effective for their situation and emphasize implementation of those activities in their conservation plan. Four of the mandatory water conservation elements require adoption of an ordinance by local governments. Generally, because of the home rule autonomy of local governments, each ordinance has to be adopted by each unit of local government for the measure to be fully implemented. Investor-owned utilities (private) do not have the authority to pass ordinances, so they must request the adoption of appropriate ordinances by local governments who have jurisdiction in that utility's service area. Utilities are not required to have a leak detection program if their unaccounted for water is less than 10 percent. An integrated program between the CUP Program and local ordinances is created when local governments have adopted the ordinances and established a compliance program.

In the period from 1988, when these requirements were first implemented, to 1995, substantial reductions in per capita consumption of about 13 percent were achieved by water utilities and their customers. This reduction in per capita use translates to a savings of approximately 118 MGD for the utilities listed in **Table 59**. This evaluation compares

**Table 59.** Changes in Per Capita Water Use for Larger Utilities within the District.

| UTILITY | 1988 | | | 1992 | | | 1995 | | | Percent Change in Per Capita Use |
|---|---|---|---|---|---|---|---|---|---|---|
| | MGD | Pop. | Per Capita Use | MGD | Pop. | PCUR | MGD | Pop. | Per Capita Use | |
| Miami-Dade Water and Sewer Department | 152.8 | 715,000 | 214 | 168 | 810,000 | 207 | 168.2 | 933,000 | 180 | -16% |
| Miami-Dade Water and Sewer Department | 153.6 | 790,000 | 194 | 158.1 | 824,000 | 192 | 166.8 | 852,000 | 196 | 1% |
| Orlando Utilities Commission | 67.25 | 309,800 | 217 | 74.6 | 339,700 | 220 | 78.48 | 353,300 | 222 | 2% |
| City of Fort Lauderdale | 54.71 | 215,300 | 254 | 50.2 | 227,000 | 221 | 48.7 | 230,000 | 212 | -17% |
| Palm Beach County Water Utilities | 24.54 | 210,000 | 117 | 32.45 | 261,600 | 124 | 33.7 | 282,500 | 119 | 2% |
| City of Boca Raton | 45 | 97,700 | 461 | 36.85 | 109,800 | 336 | 35.91 | 116,900 | 307 | -33% |
| City of West Palm Beach | | | | | | | | | | |
| Kissimmee | 5.44 | 60,000 | 91 | 12.1 | 99,900 | 121 | 13.55 | 125,200 | 108 | 19% |
| City of Cape Coral | 8.8 | 37,600 | 234 | 10 | 68,400 | 146 | 8.66 | 77,200 | 112 | -52% |
| Town of Jupiter | | | | | | | | | | |
| City of Sunrise | 13.94 | 107,100 | 130 | 15.77 | 129,200 | 122 | 18.1 | 141,800 | 128 | -2% |
| Reedy Creek Improvement District | | | | | | | | | | |
| Collier County Water Sewer District | 4.08 | 21,400 | 191 | 12.1 | 66,900 | 181 | 16.85 | 86,400 | 195 | 2% |
| City of Hollywood | 20.2 | 128,300 | 157 | 18.9 | 140,300 | 135 | 19.3 | 140,700 | 137 | -13% |
| Seacoast Utility Authority | 14 | 56,600 | 247 | 13.9 | 71,300 | 195 | 13.9 | 72,000 | 193 | -22% |
| City of Pompano Beach | 18.83 | 83,300 | 226 | 16.25 | 73,000 | 223 | 16.23 | 74,000 | 219 | -3% |
| City of Naples | 18.37 | 49,600 | 370 | 16.25 | 53,174 | 306 | 15.81 | 55,600 | 284 | -23% |
| City of North Miami Beach | | | | | | | | | | |
| Broward County Office of Environmental Protection | | | | | | | | | | |
| City of Plantation | 10 | 59,300 | 169 | 12.3 | 67,500 | 182 | 13.9 | 73,600 | 189 | 12% |
| City of Delray Beach | 11.2 | 60,400 | 185 | 12.16 | 63,100 | 193 | 12.13 | 65,300 | 186 | -0% |
| Florida Keys Aqueduct Authority | 13.2 | 129,500 | 102 | 12.99 | 139,100 | 93 | 14.08 | 144,300 | 98 | -4% |
| Orange County Public Utilities | 3.59 | 17,500 | 205 | 5.29 | 35,700 | 148 | 6.94 | 43,900 | 158 | -23% |
| City of Boynton Beach | 10.97 | 68,000 | 161 | 12.14 | 83,786 | 145 | 12.78 | 89,800 | 142 | -12% |
| City of Pembroke Pines | 6.1 | 59,000 | 103 | 7.44 | 70,100 | 106 | 9.33 | 87,900 | 106 | 3% |
| Collier County Utilities Division | | | | | | | | | | |
| Lee County Board Of Commission | 8.17 | 64,800 | 126 | 8.53 | 83,700 | 102 | 8.58 | 90,435 | 95 | -25% |
| City of Homestead | 6.96 | 30,400 | 229 | 6.1 | 30,100 | 203 | 6.47 | 32,300 | 200 | -13% |
| City of Deerfield Beach | 10.85 | 51,800 | 209 | 10.76 | 54,800 | 196 | 11.3 | 56,900 | 199 | -5% |
| City of Fort Myers | | | | | | | | | | |
| Broward County | 13.97 | 65,200 | 214 | 13.65 | 87,700 | 156 | 14.55 | 91,900 | 158 | -26% |
| Fort Pierce Utilities Authority | 8.52 | 52,000 | 164 | 9.29 | 56,400 | 165 | 9.3 | 58,600 | 159 | -3% |
| **Average** | | | **199** | | | **177** | | | **172** | **-13%** |
| **Totals** | **705.09** | **3,539,600** | | **746.12** | **4,046,260** | | **773.55** | **4,375,535** | | |

the actual water use against permanent populations of the service areas for utilities which use over four billion gallons per year. Some utilities were excluded from the evaluation because of changes in treatment efficiency and for other statistical and data availability reasons. Since these reductions are incorporated in the 1995 Base Case, the relevant issue for the LEC Plan is the additional conservation that can be achieved.

### Supplemental Measures

There are also several supplemental water conservation measures that local users could implement if they deem any of the measures to be cost-effective. Measures for urban users include indoor and outdoor retrofits and landscape audit and retrofit; public water supply utilities include filter backwash recycling and distribution pressure control; and agricultural users include irrigation audits and improved scheduling, and retrofitting with a micro irrigation system.

### Mobile Irrigation Labs

A conservation program implemented in several areas of the District, with District financial support, is deployment of Mobile Irrigation Labs (MILs). Labs are usually identified as agricultural MIL or urban MIL. Urban labs typically serve landowners with less than 10 acres of irrigated lands. These labs conduct performance evaluations for both agricultural and urban irrigation systems free of charge as a public service. The MIL program helps to develop a conservation ethic among water users while providing practical advice on how to achieve significant water savings.

Two MILs are currently serving the LEC Planning Area. An agricultural lab is headquartered at the South Dade Soil and Water Conservation District (SWCD) office in Homestead and serves Miami-Dade County. This lab also performs some urban evaluations. The other lab is headquartered at the SWCD office in West Palm Beach and performs urban evaluations in Palm Beach County. Funding for these labs has been provided by the District and the Natural Resource Conservation Service (NRCS). However, recent decisions by the Governing Board have indicated that this is not a core program for funding by the District. As a result, District participation in funding will be limited to providing staff to garner support from other agencies such as FDEP, Florida Department of Agriculture and Consumer Services (FDACS), and SWCDs, as well as users.

The annual operating cost for an urban MIL is approximately $70,000 and annual operating costs are $130,000 for an agriculture MIL. Both of these labs are working near their capacity in terms of the number of evaluations that can be performed in a year. As a result, it is recommended that an additional urban MIL should be established at the Broward County SWCD to serve the Fort Lauderdale area. Dedicated sources of funding need to be established for the existing, as well as the recommended MILs.

**Cost-Effectiveness Analysis from the FY 1998 MIL Program.** Typical costs and savings for urban and agricultural MILs such as those in Palm Beach and Miami-Dade counties are presented in **Table 60**. These costs are from the 1998 Annual

MIL Report (South Dade SWCD, 1998). The costs per 1,000 gallons saved compare favorably with alternative source development. This cost-effectiveness will be magnified to the degree that cost-savings from a single mobile lab visit extend over several years. Another environmental benefit of the urban and agricultural mobile lab program is the reduction of pollution from fertilizers and pesticides applied to urban landscapes and cropland. One of the key components of the MIL program, education, is not illustrated in this table.

**Table 60.** 1998 Mobile Irrigation Lab Costs and Estimated Water Savings.

| Lab | Annual Cost | Potential Savings (1,000 gallons per year) | Total Cost (per 1,000 gallons saved) |
|---|---|---|---|
| Urban | $70,000 | 79,500 | $0.88 |
| Agriculture | $130,000 | 1,470,000 | $0.09 |
| Total | $200,000 | 1,549,500 | $0.13 |

## Conservation Estimated Costs

The estimated conservation costs are broken down into urban and agricultural measures. The information in this section should not be interpreted as a benefit-cost analysis of these conservation measures.

**Urban Conservation Measures.** Cost and water savings for several indoor and outdoor urban retrofit water conservation measures are provided in **Tables 61** and **62**. For urban water conservation methods, the analysis indicated the value of the savings is greater than the costs of the methods. The savings per unit of cost associated with outdoor conservation measures are generally greater than those for indoor conservation measures, primarily because of the larger volumes of water involved. Water savings associated with implementation of retrofit programs can be significant. For example, retrofitting 10,000

**Table 61.** Representative Water Use and Cost Analysis for Retrofit Indoor Water Conservation Measures.

| | Toilet | Showerhead |
|---|---|---|
| Cost/unit | $200 | $20 |
| Flushes/day/person | 5 | -- |
| Gallons saved/flush | 1.9 | -- |
| Minutes/day/person | -- | 10 |
| Gallons saved/minute | -- | 2 |
| Persons/unit | 2.5 | 2.5 |
| Life | 40 years | 10 years |
| Savings/year/unit | 8,670 gallons | 9,125 gallons |
| Savings/unit over life | 346,800 gallons | 91,250 gallons |
| Cost/1,000 gallons saved | $0.58 | $0.22 |
| Gallons saved/dollar invested | 1,730 gallons | 4,560 gallons |

**Table 62.** Representative Water Use and Cost Analysis for Retrofit Outdoor Water Conservation Measures.[a]

| | |
|---|---|
| Cost/unit or visit | $68 |
| Acres/unit | 0.11 acres |
| Water savings (inches/year) | 70 inches |
| Water savings (gallons/year) | 209,070 gallons |
| Life | 10 years |
| Water savings/life | 2,090,700 gallons |
| Cost/1,000 gallons saved | $0.033 |
| Gallons saved/dollar invested | 30,750 gallons |

a. Represents additional cost of site visit (currently compensated by NRCS and the District)

showerheads in an area could result in a water savings of 182 MGY (0.50 MGD). Likewise, if 10,000 irrigation systems were retrofitted with rain switches, the water savings could be more than 2,000 MGY (5.73 MGD). One potential urban conservation method is for local governments to adopt ordinances limiting the number of days per week a home can irrigate. Such ordinances may achieve the same results as a rain switch retrofit program at significantly less cost.

**Agricultural Conservation Methods.** Conversion of existing flood irrigated citrus to micro irrigation is another potential source of water savings (**Table 63**). It is estimated by the University of Florida's Institute of Food and Agricultural Sciences (IFAS) that the initial cost to install a micro irrigation system for citrus is $1,000 per acre and the system would have estimated annual maintenance costs of $25 per acre per year (University of Florida, 1993). The table summarizes the cost and potential water savings from one acre of conversion. This comparison used the modified Blaney-Criddle formula, and the only variable that changed between the two scenarios was the efficiency factor. Return flow for flood irrigation was not accounted for. The water savings from converting 25,000 acres of citrus from flood irrigation with a 50 percent efficiency to micro irrigation with an 85 percent efficiency could result in a water savings of approximately 6,000 MGY (15.8 MGD). The analysis illustrates that given the large volumes of water used for irrigation by agriculture, water conservation savings (which can be achieved at a reasonable cost) will often be extremely cost effective compared to the costs of developing additional water supplies.

In addition to the water savings associated with conversion of flood irrigated citrus to micro irrigation, IFAS also has indicated that prescriptive applications of water and fertilizer can be made throughout the crop growing season with micro irrigation. However, micro irrigation systems generally have greater maintenance requirements than flood irrigation systems.

**Table 63.** Irrigation Costs and Water Use Savings[a] Associated with Conversion from Flood Irrigation to Micro Irrigation.[b]

| | |
|---|---|
| Initial cost/acre | $1,000 |
| Operating cost/acre | $25 |
| Water savings (inches per year) | 8.519 inches |
| Water savings (gallons/year) | 230,805 gallons |
| Life | 20 years |
| Cost over life | $1,500 |
| Water savings over life | 4,616,100 gallons |
| Cost/1,000 gallons saved | $0.33 |

a. Addresses reductions in pumpage only and does not include return flow
b. Source: IFAS and SFWMD

## Estimates of the Quantity of Water Potentially Available from Conservation

Estimates of the amount of water that could be saved (or made available) through the use of water conservation practices in the LEC Planning Area were developed as part of the Restudy, using a model developed by the Institute of Water Resources (IWR-MAIN) to simulate municipal and industrial use (USACE and SFWMD, 1999). The model was used to estimate water use to 2050, based on land use, economic, and demographic projections. Projections were made with and without the implementation of conservation practices. The projections without conservation are called Projection A. The only conservation practice they incorporate is the effect of increasing block rate structures. Conservation practices included in Projection B, the conservation projection, are that all new construction would incorporate water-conserving faucets, showerheads, and toilets, that local governments would implement ordinances to restrict lawn irrigation to the period from 9 p.m. to 5 a.m. and that irrigation systems would be equipped with rain sensors. All of these efforts represent the continued implementation of existing federal, state, and District regulations and programs. The resulting per capita consumptions are presented in **Table 64**.

**Table 64.** Average Per Capita Water Use Resulting From Projections A and B.[a]

| | Gallons/Capita/Day | |
|---|---|---|
| **Year** | **Projection A** | **Projection B** |
| 2000 | 226 | 214 |
| 2010 | 228 | 207 |
| 2030 | 220 | 189 |
| 2050 | 215 | 178 |

a. Source: USACE and SFWMD, 1999

Results of conservation analysis based on IWR-MAIN, as compared to the without conservation analysis, are shown in **Table 65**. The percentage reductions in total average use within each service area vary, but for 2020, the percentages would generally range from 12 to 13 percent. This represents an estimate of the potential savings that could result when utilities and local governments enforce existing conservation programs and regulations, especially the installation of water conserving indoor fixtures in all new and replacement installations. These estimates of significant future reductions in per capita use are in contrast to the estimates developed and used in the LEC Plan which are based on utility estimates of demand and population. On average no increase or decrease in per capita consumption is anticipated between 1995 to 2020. According to utility estimates, only a slight decrease in per capita demands is anticipated by 2020.

**Table 65.** Percent Reduction in Total Average Use Resulting from Conservation.[a]

| Service Area | 2000 | 2010 | 2030 | 2050 |
|---|---|---|---|---|
| Northern Palm Beach County | 4.96% | 9.56% | 14.32% | 17.37% |
| LECSA 1 | 4.53% | 8.66% | 13.00% | 15.76% |
| LECSA 2 | 6.18% | 10.12% | 14.92% | 18.12% |
| LECSA 3 | 5.01% | 9.26% | 14.27% | 17.71% |
| Total | 5.25% | 9.39% | 14.16% | 17.34% |

a. Extent to which conservation water use projection with conservation features in place is lower than the projection of water use without conservation (USACE and SFWMD, 1999).

## Water Conservation Conclusions

- Effective water conservation programs can provide a cost-effective means to increase available water supplies.
- Restudy efforts and water utility estimates (used in the LEC Plan) differ as to whether existing water conservation programs and laws will ultimately accomplish a reduction in per capita consumption. Efforts should be undertaken to determine if existing programs and rules are being effectively implemented and whether they are achieving the expected reduction in per capita consumption.
- Efforts should be made to increase awareness of this water supply option and help local governments, utilities, and consumers to develop a conservation ethic and implement cost-effective water conservation practices and technologies.
- Water conservation related reduction goals should be established on a user-by-user basis, considering the particular factors and opportunities that characterize each use.

## Surficial Aquifer Resources

### Definition and Discussion

The surficial aquifers are the major source of water in the LEC Planning Area. The Surficial Aquifer System (SAS) includes two major aquifers in the LEC Planning Area. The Biscayne aquifer is located within Miami-Dade, Broward, and southern Palm Beach counties. An undifferentiated surficial aquifer is found in the remainder of Palm Beach County. The entire SAS is unconfined, consisting of varying amounts of limestone and sediments that extend from the land surface to the top of an intermediate confining unit. This intermediate confining unit consists of several hundred feet of low-permeability clays and marls and effectively separates the SAS from the underlying Floridan Aquifer System (FAS) in much of the planning area. Almost all municipal and irrigation water is obtained from the SAS in South Florida.

The second aquifer system, the FAS, is divided into the upper and the lower Floridan aquifers by a middle confining layer. The Floridan aquifer is a source of fresh water north of Lake Okeechobee (e.g., Orlando area), but moving south of Lake Okeechobee and into South Florida, the aquifer deepens and becomes more mineralized. The upper Floridan aquifer along the lower east coast, from Jupiter to south Miami, is comprised of brackish water and in some cases is used as a source of water for reverse osmosis systems and for storage of potable water using ASR technology.

The lower Floridan is isolated from the upper Floridan by several hundreds of feet of confining units. The lower Floridan aquifer contains a highly transmissive, cavernous zone of limestone locally known as the boulder zone. Because this zone contains highly saline water, it is not used as a source of drinking water and is not considered as a potential source of water in this plan.

#### Alter Secondary Canal Operations to Capture, Store, and Utilize Additional Local Water

This water supply option includes structural and operational changes that allow capturing of additional runoff water which will be held in the secondary canal systems. A portion of the water captured in the secondary canal systems will come from excess water in the primary canal system, while some will be water captured within the secondary system itself. This option will also foster the utilization of this water by allowing appropriate reductions in water levels before water is obtained from regional sources to replenish water in the secondary canal systems. One objective of this option is to stabilize the salt front by holding higher surface and ground water levels in coastal areas. Higher ground water levels should also help to recharge wellfields and decrease the frequency of water shortages. Modifying secondary canal operations will improve local water use and recharge, and will help to reduce the need to bring water in from regional sources. If higher water levels will be held, the potential impacts on flood protection must be considered.

This Broward County Secondary Canal Network is currently being implemented as part of the LEC Interim Plan and this plan recommends continuation and completion of that effort. A similar component is recommended under the CERP to enhance secondary canal delivery capability in central and southeast coastal Broward County.

### Utility Aquifer Storage and Recovery Systems

This water supply option involves the storage of surface water or surficial ground water in the upper Floridan aquifer during periods of abundant water, and recovery of that water during dry periods. Utility ASR systems, in most cases, involve the storage of treated water. Storage of water takes place during periods of low utility demands when excess treatment capacity is available. Recovery of the stored water takes place during periods of high demands to supplement treatment plant production.

Within the LEC Planning Area, this water supply option has been in use for several years by the City of Boynton Beach's water utility. In addition, the Miami-Dade Water and Sewer Department (WASD) has constructed several large ASR facilities which operate utilizing untreated ground water prior to treatment by the water plants. The LEC Interim Plan provided financial support for development of the Miami-Dade WASD ASR facilities because of their positive impact on the regional water resources of the area.

### Relocation or Expansion of Surficial Wellfields

This water supply option involves the development of surficial wellfields, an option which is traditionally undertaken when developing or expanding surficial water treatment facilities Locations of surficial water withdrawals are permittable if they meet the reasonable-beneficial use test and will not cause saltwater intrusion or harm wetlands or adjacent legal water users.

Information provided to the District by water utilities in the LEC Planning Area, indicates that many utilities are planning for additional surficial aquifer wellfield expansion. Twenty utilities reported that they expected additional production only from existing wellfields, while five reported that they will be developing wellfield capacity at new locations. In addition, LEC planning efforts have identified a number of opportunities for wellfield relocation. Moving existing demands to new locations could reduce or eliminate potential saltwater intrusion problems during dry periods and greatly increase the ability to access water from the regional canal distribution system

### Interconnections with Other Utilities

This water supply option makes use of interconnects between water utilities to deliver either raw or treated water from one utility to another. Interconnects are useful in moving raw water from an area with adequate water resources to one where water resources are limited. Utilities may also use treated water interconnections when one utility has inadequate treatment capacity to meet its demands. Forty-five utilities in the LEC Planning Area have some form of interconnection with other utilities to provide transfer of water.

### Secondary Canal Interconnections to Improve Delivery of Regional Water

This water supply option includes the physical facilities that would increase the connectivity among and between the coastal drainage basins and the regional system. These facilities would be used to increase deliveries of regional water to locations where higher water levels are needed to recharge wellfields and prevent saltwater intrusion.

### Lower Elevations of Existing Municipal Intake Structures

This water supply option applies to utilities which obtain their water from Lake Okeechobee and may have difficulty withdrawing water at lower lake levels. Lowering the elevations of intake structures will allow the utilities to continue to withdraw water during periods when Lake Okeechobee levels are abnormally low.

The cities of Belle Glade, South Bay, Pahokee, Okeechobee, and Okeelanta water utilities take water directly from Lake Okeechobee and should carefully evaluate the capability of their present water intakes to operated at low lake levels. The incremental evaluations conducted as a part of this plan indicate that until major storage components in the Lake Okeechobee Service Area (LOSA) come on-line, there is a significant possibility of very low lake levels during severe droughts.

## Surficial Aquifer System Estimated Costs

The costs related to well construction for the SAS are provided in **Table 66**. There are additional costs for water treatment for potable uses. Many of the treatment facilities in the planning area use lime softening for surficial aquifer water. Lime softening's cost advantages are in operating and maintenance expenses (**Table 67**), where costs are typically 20 percent less than for comparable membrane technologies. However, membrane softening is being used by utilities to enhance or replace traditional lime softening due to more stringent water quality standards. The cost of membrane softening is indicated in **Table 68**. One significant advantage over lime softening is membrane softening's effectiveness at removing organic chemicals that function as precursors to the formation of disinfection by-products, such as trihalomethanes.

**Table 66.** Surficial Aquifer System Well Costs.[a]

| | Drilling Cost (per well) | Equipment Cost (per well) | Engineering Cost (per well) | Operations and Maintenance Cost (per 1,000 gallon) | Energy Cost (per 1,000 gallon) |
|---|---|---|---|---|---|
| Costs | $45,000 | $62,000 | $16,000 | $0.004 | $0.025 |

a. Costs based on a 16-inch diameter well and a maximum well depth of 200 feet; Source: *Water Supply Cost Estimates* (PBS&J, 1991), converted to 1999 dollars

**Table 67.** Lime Softening Treatment Costs.[a]

| Facility Size (MGD) | Capital Cost (per gallon/ day capacity) | Engineering Cost (per gallon/ day capacity) | Land Requirements (acres) | Operations and Maintenance Cost (per 1,000 gallon) | Energy Cost (per 1,000 gallons) |
|---|---|---|---|---|---|
| 3 | $1.63 | $0.25 | 1.5 | $0.60 | $0.023 |
| 5 | $1.57 | $0.24 | 2.5 | $0.56 | $0.023 |
| 10 | $1.53 | $0.23 | 4.0 | $0.50 | $0.021 |
| 15 | $1.26 | $0.19 | 6.0 | $0.41 | $0.020 |
| 20 | $1.13 | $0.16 | 8.0 | $0.38 | $0.020 |

a. Source: *Water Supply Cost Estimates* (PBS&J, 1991), converted to 1999 dollars

**Table 68.** Membrane Softening Costs.[a]

| Facility Size (MGD) | Capital Cost (per gallon/ day capacity) | Engineering Cost (per gallon/ day capacity) | Land Requirements (acres) | Operations and Maintenance Cost (per 1,000 gallon) | Energy Cost (per 1,000 gallons) |
|---|---|---|---|---|---|
| 3 | $1.67 | $0.25 | 0.40 | $0.55 | $0.200 |
| 5 | $1.52 | $0.23 | 0.40 | $0.53 | $0.200 |
| 10 | $1.41 | $0.21 | 0.50 | $0.50 | $0.200 |
| 15 | $1.38 | $0.21 | 0.63 | $0.48 | $0.200 |
| 20 | $1.33 | $0.20 | 0.78 | $0.46 | $0.200 |

a. Source: *Water Supply Cost Estimates* (PBS&J, 1991), converted to 1999 dollars

## Quantity of Water Potentially Available from the Surficial Aquifer System

From a regional perspective, increases in production from the Biscayne aquifer along the coast beyond existing demands appears limited due to potential saltwater intrusion. Based on this assessment, it was concluded the Biscayne aquifer is, nevertheless, sufficient to meet urban and agriculture demand through 2020. Some further development of the aquifer can be accomplished at the local level through modifications to wellfield locations, configurations, and pumping regimes, and by increasing storage, such as through the use of reservoirs or ASR. Developing wellfield configurations and pumping regimes has been successfully used in most CUP activities to maximize use of the resource and avoid causing harm to natural systems. As a result, water availability will have to be evaluated on a project-by-project basis in some areas. The volume of water that could be withdrawn by any specific user must be determined through the District's CUP program.

### Surficial Aquifer System Conclusions

- The SAS, including the Biscayne aquifer, is the primary source of water in the LEC Planning Area existing. Existing and new wellfields being developed are anticipated to provide most of the water needed in the future so that approximately 1,200 MGD can be consumed from this source for public water supply by 2020.

- This water is generally of excellent quality, wells have excellent yields, and treatment costs are low.
- In some areas, withdrawals from the SAS are periodically threatened by saltwater intrusion and there is limited or no access to water from the regional system. In areas where yields are limited by low production rates, aquifer contamination, or saltwater intrusion, alternative sources may be considered, including the need to relocate wellfields to safer and more productive locations.

## Floridan Aquifer System

### Definition and Discussion

The Floridan Aquifer System (FAS) underlies all of Florida and portions of southern Georgia and Alabama. It is the principal source of water in Central Florida, but yields only nonpotable water throughout most of the LEC Planning Area. The quality of water in the FAS deteriorates southward, increasing in hardness and salinity. With depth, the salinity increases, making the deeper producing zones less suitable for the water supply development than the shallower zones near the top of the aquifer. Within the planning area, the FAS is not influenced by variations in rainfall.

Water from the shallow zones must be treated by desalination to produce a potable product. The most productive zones in the FAS are the lower Hawthorn and Suwannee aquifers. Several utilities in the planning area are considering use of water from the FAS to meet their needs. Elsewhere in the planning area, these aquifers supply only a few agricultural irrigation wells. With continued growth and development in the LEC Planning Area, these aquifers may become a significant source of water to meet the demand. Although desalination of the water will be necessary for potable use, blending of the raw water with higher quality water could produce a product suitable for irrigation purposes.

In the deeper zone of the FAS, areas of extremely high transmissivity exist, termed boulder zones. These zones are not used for supply sources within the planning area due to high salinity and mineral content of the water. However, treated wastewater effluent and concentrate or residual brines from the desalination process are injected into this zone as a means of disposal. In addition, zones within the upper portion of the FAS are also used for ASR. Utilities in Palm Beach, Broward, and Miami-Dade counties are currently testing the feasibility of ASR.

Limited information, data, and experience are available regarding the use of the FAS within the LEC Planning Area. Some utilities are considering the use of the FAS to meet existing and future demands. While water quality and the long-term sustainability of the FAS are concerns, significant changes in water quality are not anticipated. Development of a comprehensive FAS ground water model by the District for Palm Beach, Broward, and Miami-Dade counties to be used for predictive analysis in the future

is recommended. Currently, some local FAS models are being used. However, these models have very limited capabilities based on the available hydraulic information.

Currently, utilities are drilling into the FAS in the LEC Planning Area for water supply and wastewater disposal. The District should work in conjunction with water users and utilities to gain water quality and hydraulic information related to these FAS well drilling programs. Information could be gained via packer tests, coring/testing of specific intervals plus geophysical logging (e.g. permeability logs), and aquifer performance testing. In most cases, these activities would be nominal compared to the actual well drilling cost. The District should consider budgeting with utilities for this these items and cost-share for additional testing and data acquisition. It is also recommended that a FAS monitoring network be established to collect the data necessary to establish the relationships among water use, water levels, and water quality.

Recent improvements in low pressure membranes have reduced the electrical costs associated with reverse osmosis systems. Because reverse osmosis pump power consumption is directly proportional to pressure, the low pressure systems can require significantly less power. The reverse osmosis treatment costs presented herein do not reflect the recent improvements in membrane technology.

### Floridan Aquifer System Blending

Under this water supply option, water utilities would blend brackish water from the FAS with Biscayne or surficial fresh water. Sodium concentration and other quality considerations would limit the amount of Floridan water used in blending. The FAS in the Lower East Coast Planning Area is a brackish aquifer that lies below the Biscayne aquifer and is separated from the Biscayne by approximately 700 feet of low permeability sediments. The ground water of the FAS is independent of the LEC Planning Area's surface water and SAS. The upper Floridan aquifer is preferred as a potential source of water for blending given its relatively low salinity.

### Brackish Water Desalination

Under this water supply option, water utilities would use reverse osmosis or other appropriate treatment process (electrodialysis or ion exchange) to recover fresh water that meets drinking water standards from the brackish water of the FAS that underlies the LEC Planning Area. The FAS lies below the Biscayne aquifer and is separated from the Biscayne by approximately 700 feet of low permeability sediments. The ground water of the deeper FAS is independent of the planning area's surface water and the SAS. The upper Floridan is preferred as a potential source for reverse osmosis treatment because of its relatively low salinity levels. Reverse osmosis and distillation take the water out of the salt solution. Electrodialysis and ion exchange take the salt out of the salt solution. Reverse osmosis is presently being used by a number of utilities in the planning area and may become more common as it provides very good water and helps utilities meet drinking water standards that are sometimes difficult to meet using conventional treatment technologies.

## Floridan Aquifer System Estimated Costs

The costs related to wellfield development of the FAS are provided in **Table 69**. Desalination treatment for potable water use, such as reverse osmosis (**Table 70**) and concentrate disposal, incur additional costs (**Table 71)**. Site-specific costs associated with reverse osmosis can vary significantly as a result of source water quality, concentrate disposal requirements, land costs, and use of existing water treatment plant infrastructure. As a general rule, reverse osmosis costs are 10 to 50 percent higher than lime softening depending on the water quality of the source water. For brackish water with total dissolved solids up to 10,000 mg/L, electrodialysis and electrodialysis reversal are generally effective, but cost about 5 to 10 percent higher than reverse osmosis treatment (Boyle Engineering, 1989).

## Quantity of Water Potentially Available from the Floridan Aquifer System

Several utilities have recently considered use of the FAS. Limited information, data, and experience are available regarding the use of the FAS in the LEC Planning Area. Regional FAS ground water models do not exist for the LEC Planning Area. The assessments within this plan did not incorporate a water quality component nor does sufficient data exist to conduct such an analysis. However, based on the limited data, knowledge, and experience in the LEC Planning Area, as well as FAS experience in other areas, it was concluded that the FAS could support all of the existing and projected demands for the potable water utilities without causing significant changes in water quality in the FAS. As stated previously, development of a FAS ground water model and monitoring program are recommended for conducting predictive analyses in the future.

**Table 69.** Floridan Aquifer System Well Costs.[a]

| | Drilling Cost (per well) | Equipment Cost (per well) | Engineering Cost (per well) | Operations and Maintenance Cost (per 1,000 gallon) | Energy Cost (per 1,000 gallon) |
|---|---|---|---|---|---|
| Costs | $115,000 | $65,000 | $18,000 | $.004 | $.040 |

a. Costs based on a 16-inch diameter well and a maximum well depth of 200 feet; Source: *Water Supply Cost Estimates* (PBS&J, 1991), converted to 1999 dollars

**Table 70.** Reverse Osmosis Costs to Treat Water from the Floridan Aquifer System.[a]

| Facility Size (MGD) | Capital Cost (per gallon/ day capacity) | Engineering Cost (per gallon/ day capacity) | Land Requirements (acres) | Operations and Maintenance Cost (per 1,000 gallon) | Energy Cost (per 1,000 gallons) |
|---|---|---|---|---|---|
| 3 | $1.76 | $.26 | .40 | $.58 | $.29 |
| 5 | $1.59 | $.24 | .40 | $.54 | $.29 |
| 10 | $1.47 | $.23 | .50 | $.51 | $.29 |
| 15 | $1.43 | $.21 | .63 | $.50 | $.29 |
| 20 | $1.46 | $.20 | .78 | $.38 | $.29 |

a. Costs based on 2,000 mg/L TDS, 400 PSI; Source: *Water Supply Cost Estimates* (PBS&J, 1991), converted to 1999 dollars

**Table 71.** Concentrate Disposal Costs for Reverse Osmosis Disposal.[a]

| Deep Well Disposal Facility (MGD) | Capital Cost (per gallon/ day capacity) | Engineering Cost (per gallon/ day capacity) | Land Requirements (acres) | Operations and Maintenance Cost (per 1,000 gallon) |
|---|---|---|---|---|
| 3 | $.73 | $.109 | 0.5 | $.040 |
| 5 | $.55 | $.083 | 0.5 | $.030 |
| 10 | $.50 | $.075 | 1.0 | $.028 |
| 15 | $.46 | $.070 | 2.0 | $.025 |
| 20 | $.38 | $.056 | 3.0 | $.020 |

a. Source: *Water Supply Cost Estimates* (PBS&J, 1991), converted to 1999 dollars

### Floridan Aquifer System Conclusions

- The FAS has the potential to yield large quantities of water for potable use, but the exact quantities are unknown at this time.
- Within the LEC planning Area, the FAS is not influenced by variations in rainfall and could be considered drought proof.
- Treatment costs are moderate and are declining as technology improves.
- Local water users could consider using the FAS as an alternative or supplemental source of water to reduce demands on conventional freshwater sources during dry periods.
- Any efforts to conduct FAS well drilling programs in the LEC Planning Area should be coordinated to facilitate collection of water quality and hydraulic information.

## Reclaimed Water

### Definition and Discussion

This section uses the following definitions of terms:

- Reclaimed water - Water that is reused for a beneficial purpose after flowing out of a wastewater treatment facility.
- Reuse - The deliberate application of reclaimed water for a beneficial purpose.
- Treatment Plant Capacity - The permitted capacity or maximum amount of wastewater that a wastewater treatment plant can treat.
- Treatment Plant Flow - The average annual flow or amount of wastewater that actually flows through a wastewater treatment plant.

- Reuse Capacity - The permitted capacity or maximum amount of reclaimed water that a reuse system can accommodate or distribute.
- Reuse Flow - The average annual flow or amount of reclaimed water actually being allocated or distributed to a reuse system or activity.

In 1997, wastewater facilities in Palm Beach, Broward, Miami-Dade, and Monroe counties treated an average of 673 MGD of wastewater, of which 48 MGD (about seven percent) was reused. The treatment capacities and flows for facilities that provided reuse water during 1997 are listed in **Table 72**. Reuse of reclaimed water takes place when

**Table 72.** Domestic Wastewater Treatment Facilities Providing Reuse.

| Facility | Facility ID | Capacity (MGD) | Flow (MGD) |
|---|---|---|---|
| **Palm Beach County** | | | |
| A Garden Walk | FLA013735 | 0.10 | 0.08 |
| Belle Glade Wastewater Treatment Plant (WWTP) | FLA027740 | 3.00 | 2.70 |
| Bryant Village/US Sugar Corporation | FLA013704 | 0.17 | 0.07 |
| City Of Boca Raton WWTP | FL0026344 | 17.50 | 13.89 |
| East Central Regional Wastewater Treatment Facility (WWTF) | FLA013674 | 55.00 | 40.00 |
| Loxahatchee Environmental Control District | FL0034649 | 8.00 | 4.96 |
| Okeelanta Corporation | FLA013706 | 0.23 | 0.03 |
| Palm Beach County Southern Regional Facility | FLA041424 | 30.00 | 18.81 |
| Royal Palm Beach Village WWTF | FLA013749 | 2.20 | 1.73 |
| Seacoast Utilities PGA | FL0038768 | 8.00 | 6.55 |
| South Central Regional WWTF | FL0035980 | 24.00 | 16.50 |
| Palm Beach County Total | | 148.20 | 105.32 |
| **Broward County** | | | |
| Broward County North Regional | FL0031771 | 80.00 | 65.95 |
| City of Hollywood | FL0026255 | 42.00 | 35.00 |
| City of Sunrise SW WWTF | FLA013580 | 0.99 | 0.48 |
| Plantation Regional WWTP | FL0040401 | 15.00 | 12.58 |
| Pompano Beach | FLA013581 | 2.50 | 1.35 |
| Broward County Total | | 140.49 | 115.36 |
| **Miami-Dade County** | | | |
| Homestead | FLA013609 | 2.25 | 2.25 |
| Krome Service Processing Center | FLA013605 | 2.25 | 2.47 |
| Miami-Dade WASD Southern District WWTF | FL0042137 | 88.73 | 85.14 |
| Miami-Dade Central District WWTF | FLA024805 | 150.84 | 132.24 |
| Miami-Dade Northern District WWTP | FL0032182 | 116.94 | 98.77 |
| Miami-Dade County Total | | 361.01 | 320.87 |
| **Monroe County** | | | |
| Duck Key WWTF | FLA014772 | 0.10 | 0.10 |
| Key West Resort Utility | FLA014951 | 0.50 | 0.19 |
| Monroe County Total | | 0.60 | 0.29 |
| **LEC Planning Area Total** | | **650.30** | **541.84** |

treated wastewater which would otherwise be disposed of in a way that represents a loss to the freshwater system is instead reapplied to that system. The reclaimed water may directly substitute for an existing use or it may indirectly make more water available for use by increasing the recharge of ground or surface waters. The benefits include enhancement to the water supply by the introduction of a new source that can help meet projected nonpotable demands. Reuse included irrigation of golf courses, residential lots, medians, and other green space and ground water recharge via percolation ponds.

Reclaimed water plays a significant role in meeting the needs of this region and this is expected to increase in the future. The amount of water reused by each utility and the type of reuse are shown in **Table 73**. Some options for reuse of reclaimed water at a regional-scale were mentioned previously under the description of CERP Projects. In addition, many jurisdictions or utilities in the LEC Planning Area presently use reclaimed water in a variety of ways, and additional applications are being investigated.

**Table 73.** Reclaimed Water Utilization.

| Reuse System | Reuse Type[a] | Reuse Subtype[b] | Capacity (MGD) | Flow (MGD) | Area (acres) |
|---|---|---|---|---|---|
| **Palm Beach County** | | | | | |
| A Garden Walk | GWR&IPR | RIB | 0.08 | 0.08 | 6 |
| Belle Glade WWTP | GWR&IPR | RIB | 0.07 | 1.23 | 7 |
| Boca Raton (Project Iris) | PAA&LI | OPAA | 2.10 | 0.75 | |
| Boca Raton (Project Iris) | PAA&LI | RI | 8.00 | 0.68 | |
| Boca Raton (Project Iris) | PAA&LI | GCI | 2.90 | 0.51 | |
| Boca Raton (Project Iris) | IND | ATP | 0.90 | 0.90 | |
| East Central Regional WWTP | WL | NA | 0.15 | 0.03 | 2 |
| Loxahatchee Environmental Control District | IND | ATP | 1.00 | 0.46 | |
| Loxahatchee Environmental Control District | PAA&LI | RI | 0.10 | 0.07 | 43 |
| Loxahatchee Environmental Control District | PAA&LI | GCI | 5.66 | 3.18 | 1300 |
| Loxahatchee Environmental Control District | PAA&LI | OPAA | 0.70 | 0.59 | 130 |
| Okeelanta Corporation | GWR&IPR | RIB | 0.23 | 0.03 | 3 |
| Palm Beach County Southern Regional | PAA&LI | RI | 1.32 | 1.32 | |
| Palm Beach County Southern Regional | PAA&LI | GCI | 0.84 | 0.84 | |
| Palm Beach County Southern Regional | IND | ATP | 3.70 | 3.70 | |
| Palm Beach County Southern Regional | WL | NA | 3.00 | 1.45 | |
| Royal Palm Beach Village Utilities | GWR&IPR | RIB | 1.24 | 0.76 | 20 |
| Seacoast Utilities PGA | PAA&LI | OPAA | 0.00 | 0.05 | 24 |
| Seacoast Utilities PGA | PAA&LI | RI | 0.00 | 0.18 | 63 |
| Seacoast Utilities PGA | PAA&LI | GCI | 8.00 | 2.10 | 1531 |
| South Central Regional WWTP | IND | ATP | 1.80 | | |
| South Central Regional WWTP | PAA&LI | GCI | 0.57 | 1078 | |
| U.S. Sugar Corp Bryant Village | GWR&IPR | RIB | 0.17 | 0.07 | |
| Palm Beach County Total | | | 40.16 | 21.34 | 4206 |
| **Broward County** | | | | | |
| Broward County North Regional | IND | AOF | 1.31 | 1.31 | |

**Table 73.** Reclaimed Water Utilization.

| Reuse System | Reuse Type[a] | Reuse Subtype[b] | Capacity (MGD) | Flow (MGD) | Area (acres) |
|---|---|---|---|---|---|
| Broward County North Regional | IND | ATP | 3.29 | 3.29 | |
| Broward County North Regional | PAA&LI | OPAA | 1.74 | 1.74 | 30 |
| City of Sunrise (South Broward) | GWR&IPR | RIB | 1.00 | 0.48 | 5 |
| Hollywood | PAA&LI | GCI | 4.00 | 2.82 | 753 |
| Plantation Regional | IND | ATP | 2.16 | 0.73 | |
| Pompano Beach | PAA&LI | GCI | 2.05 | 1.10 | 323 |
| Pompano Beach | PAA&LI | OPAA | 0.45 | 0.25 | 76 |
| Broward County Total | | | 16.01 | 11.73 | 1188 |
| **Miami-Dade County** | | | | | |
| Homestead | GWR&IPR | RIB | 2.25 | 2.25 | 14 |
| Krome Service Processing Center | GWR&IPR | AF | 2.25 | 2.47 | |
| Miami-Dade WASA Central District WWTF | IND | ATP | 7.84 | 4.24 | |
| Miami-Dade WASD N District WWTP | PAA&LI | OPAA | 1.50 | 0.06 | 40 |
| Miami-Dade WASD N District WWTP | IND | ATP | 2.94 | 2.70 | |
| Miami-Dade WASD South District WWTF | IND | ATP | 3.73 | 3.40 | |
| Miami-Dade County Total | | | 20.51 | 15.12 | 54 |
| **Monroe County** | | | | | |
| Duck Key Wastewater Cooperative | PAA&LI | OPAA | 0.10 | 0.05 | 20 |
| Key West Resort Utility | PAA&LI | GCI | 0.50 | 0.19 | 60 |
| Monroe County Total | | | 0.60 | 0.24 | 80 |
| LEC Planning Area Total | | | **227.28** | **48.43** | **5,528** |

a. Reuse Types: PAA&LI - Public Access Areas and Landscape Irrigation; AI - Agricultural Irrigation; GWR&IPR - Ground Water Recharge and Indirect Potable Reuse; IND - Industrial; TF - Toilet Flushing; FP - Fire Protection; WL - Wetlands; OTH - Other

b. Reuse Subtypes; GCI - Golf Course Irrigation; RI - Residential Irrigation; OPAA - Other Public Access Areas; EC - Edible Crops; OC - Other Crops; RIB - Rapid Infiltration Basins; AF - Absorption Fields; SWA - Surface Water Augmentation; INJ - Injection; ATP - At Treatment Plant; AOF - At Other Facilities; NA - Not applicable

Potential uses of reclaimed water include landscape and agricultural irrigation, ground water recharge, industrial uses, and environmental enhancement. The ground water modeling associated with this plan found the existing and projected reuse of reclaimed water in the coastal portions of the planning area helped reduce the potential of exceeding wetland protection and seawater intrusion criteria. The volume of reclaimed water that is reused is projected to increase as wastewater flows increase due to development and as current/proposed reuse programs are implemented. In addition to supporting continuation of implementation of the utility plans, several options to increase the effectiveness and efficiency of these programs, especially during low rainfall periods, are discussed.

In addition to using reclaimed water for irrigation, reclaimed water has potential for use as a saltwater intrusion barrier. For the Biscayne aquifer, this use could be accomplished by applying reclaimed water at land surface through percolation ponds or trenches along the coast, or by discharge to coastal canals, thereby creating a freshwater

mound that would impede the movement of salt water inland. Alternatively, a series of injection wells could be constructed along the coast to accomplish the same result. However, these methods would have to comply with federal and state underground injection requirements.

### Reclaimed Water Estimated Costs

The costs associated with implementation of a reclaimed water program can vary significantly depending on the type of reuse system (i.e., ground water recharge, public access irrigation, etc.), the capacity of the reclamation facility, treatment components, the extent of the reclaimed water distribution system, and regulatory requirements. Cost savings include negating the need for, or reducing the use of, alternative disposal systems; reducing the demand on ground water systems; and reducing the volume of potable water used for irrigation.

For a reuse system that utilizes reclaimed water for public access irrigation, utility representatives indicated infrastructure cost would be approximately $1.00 per 1,000 gallons, while the operation and maintenance of the system would be approximately $0.21 per 1,000 gallons. For public access irrigation systems using reclaimed water, the infrastructure cost would include the costs associated with construction of advanced secondary treatment components including filtration, high level disinfection, online continuous water quality monitoring, storage, pumps, transmission, and distribution facilities. Operation and maintenance costs would include chemical, pumping, and maintenance for the treatment and distribution system.

### Quantity of Water Potentially Available from Reclaimed Water

**Table 73** indicates current wastewater facilities that are reusing wastewater have a reuse capacity of 227 MGD and a current reuse flow of 48 MGD. An additional 23 utilities in the LEC Planning Area, with 177 MGD capacity and average flow of 131 MGD, presently do not reclaim water for reuse (**Table 74**). Hence, a capacity for development of approximately 356 MGD presently exists within the region. Water use within the region was about 784 MGD in 1995 and is projected to increase to 1,213 MGD by 2020, which is an increase of about 55 percent. If wastewater flow increases proportionally, this corresponds to about 1,050 MGD of wastewater flow. If the proportion of wastewater that is reused remains the same, this translates to about 70 MGD. Present reuse capacity is about 34 percent of total wastewater flow. If this proportion remains the same in the future, wastewater treatment would represent a capacity of about 357 MGD by 2020.

The potential need in the future to integrate water conservation and reclaimed water systems has been considered. The concept is that reuse systems should be designed to apply reclaimed water to meet water supply needs and provide aquifer recharge, rather than as a system to make this water inaccessible.

**Table 74.** Disposal Facilities[a] with No Reuse.

| Facility | Facility ID | Capacity (MGD) | Flow (MGD) |
|---|---|---|---|
| **Palm Beach County** | | | |
| Acme Improvement District | FLA042595 | 3.00 | 2.40 |
| East Central Regional WWTP | FL0041360 | 55.00 | 40.00 |
| Pahokee WWTP | FLA136778 | 1.20 | 1.08 |
| Pratt and Whitney | FLA013693 | 0.22 | 0.09 |
| South Bay WWTP | FLA021300 | 1.42 | 0.78 |
| **Palm Beach County Total** | | 60.84 | 44.35 |
| **Broward County** | | | |
| City of Margate East Plant | FL0169617 | 2.20 | 0.00 |
| City of Margate WWTP | FL0041289 | 8.00 | 8.23 |
| City of Miramar WWTF | FLA017025 | 8.90 | 0.00 |
| City of Pembroke Pines | FLA013575 | 7.69 | 4.22 |
| Cooper City West WWTP | FL0040398 | 2.50 | 2.90 |
| Coral Springs Improvement District WWTF | FLA041301 | 5.50 | 5.00 |
| Ferncrest | FLA013583 | 0.60 | 0.30 |
| Fort Lauderdale - G.T. Lohmeyer | FL0041378 | 43.00 | 38.31 |
| Sunrise No. 1 WWTF | FLA041947 | 9.00 | 7.07 |
| Sunrise No. 2 WWTP | FLA042633 | 3.00 | 1.81 |
| Sunrise No. 3 WWTP | FLA042641 | 13.75 | 9.05 |
| Town of Davie WWTP | FL0040541 | 3.00 | 2.28 |
| **Broward County Total** | | 107.14 | 79.17 |
| **Miami-Dade County** | | | |
| American Village MHP | FLA013641 | 0.20 | 0.13 |
| Cricket Club, The | FLA013637 | 0.10 | 0.07 |
| **Miami-Dade County Total** | | 0.30 | 0.20 |
| **Monroe County** | | | |
| Key Haven Utility | FLA014867 | 0.20 | 0.19 |
| North Key Largo WWTP | FLA015009 | 0.55 | 0.29 |
| Richard A. Heyman WWTP-Key | FL0025976 | 7.20 | 7.20 |
| **Monroe County Total** | | 7.95 | 7.68 |
| **LEC Planning Area Total** | | **176.23** | **131.40** |

a. Domestic Wastewater Treatment Facilities

## Reclaimed Water Conclusions

- Only about 48 MGD of reclaimed water is used in the LEC Planning Area today, although the existing reuse capacity is about 227 MGD.
- Reclaimed water has the potential to help meet irrigation demands and to enhance regional resources, including wetlands and aquifer systems and to help meet the freshwater flow requirements of estuaries.
- If current trends continue, reuse capacity in the region could increase to 357 MGD by 2020.

- Supplemental sources and interconnection with other utilities may provide an effective means to improve the volume of reclaimed water reused.
- The cost of using reclaimed water for irrigation greatly exceeds the cost of available conventional supplies. However, in areas where conventional supplies are not available, reclaimed water use is cost-effective.
- Large-scale reclaimed water projects involving environmental hydropattern enhancement and/or aquifer recharge have regulatory issues which need to be carefully addressed for such projects to be cost-effective.

## Seawater Desalination

### Definition and Discussion

This water supply option involves using seawater from the Atlantic Ocean as a raw water source. The Atlantic Ocean appears to be an unlimited source of water from a quantity perspective; however, removal of the salts is required before that water can be used for potable or irrigation purposes. A desalination treatment technology would have to be used, such as distillation, reverse osmosis, or electrodialysis.

### Seawater Estimated Costs

The cost of desalination of seawater is estimated to be significant, up to eight times the cost of reverse osmosis water from the FAS. In addition, reverse osmosis and facilities treating seawater would be expected to have an efficiency of 25 percent, resulting in increased concentrate/reject water disposal needs compared to desalination of the brackish water of the upper Floridan aquifer.

Tampa Bay Water, located in the Southwest Florida Water Management District, is moving ahead to construct a seawater desalination treatment facility initially capable of producing 25 MGD of drinking water with estimated first year costs as low as $1.71 per thousand gallons, significantly lower than originally assumed and significantly below the costs for water at similar plants under construction elsewhere. For example, in Singapore, a 36 MGD desalination plant is estimated to produce water that will cost between $7.52 and $8.77 per thousand gallons.

Some of the factors reducing the cost of this facility include colocating the water treatment plant with a power plant, using the power plant’s existing cooling water discharge system for concentrate disposal, and using the power plant’s existing facilities for the intake to the water treatment plant. The District is in the process of soliciting proposals to conduct a feasibility study of colocating seawater reverse osmosis water treatment facilities with coastal electrical power plants in the District's area of jurisdiction.

### Seawater Desalination Conclusions

- Seawater desalination can provide an unlimited amount of high quality water for potable use.
- The costs of seawater desalination are generally high, depending on the quality of source water, due primarily to high energy costs associated with reverse osmosis. These costs are declining as reverse osmosis technology improves.
- Utilities considering seawater desalination should consider coordinating with the District and other agencies to examine the need for this alternative, current trends in technology, and options to combine this approach with other methods.

## Aquifer Storage and Recovery

### Definition and Discussion

Aquifer Storage and Recovery (ASR) can be treated as either a regional water resource project or as a local water supply option, depending on the project location, scale, and population served. Regional-scale applications of this technology were discussed previously. The following information provides general information that may be useful for planning efforts by local utilities.

ASR is the underground storage of high quality water in an acceptable aquifer (typically the upper Floridan aquifer in the LEC Planning Area) through a well during times when water is available, and the subsequent recovery of that water from that same well during high demand periods. In other words, the aquifer acts as an underground reservoir for the injected water, reducing water loss due to evaporation.

Current regulations require injected water to meet drinking water standards when the receiving aquifer is classified as an Underground Source of Drinking Water (USDW) aquifer, unless an aquifer exemption is obtained from the U.S. Environmental Protection Agency (USEPA). Obtaining an aquifer exemption is a rigorous process and few have been approved. However, the USEPA has indicated a willingness to utilize a more flexible permitting approach for proposed ASR systems that can meet all drinking water standards with the exception of coliform bacteria. This additional flexibility should assist in permitting raw water ASR facilities in the LEC Planning Area.

#### Treated Water ASR

Treated water ASR involves using potable water as injection water. Since potable water meets the drinking water standards, this type of ASR application is more easily permitted. There are many examples in Florida, including several in the LEC Planning Area, of utilities using treated water ASR. These include the city of Boynton Beach ASR facility which has been in successful operation for several years.

### Raw Water ASR

The development of raw water as a source for ASR systems is under way by some utilities in the LEC Planning Area. The Miami-Dade WASD has constructed several ASR wells in their wellfields, which will store untreated surficial aquifer water until it is needed by the system's water treatment facilities. Currently, no operating, untreated, surface water ASR projects are located in Florida.

### Reclaimed Water ASR

Reclaimed water ASR would involve using reclaimed water as the injection water. Currently, there are no operating, reclaimed water ASR projects in Florida. Several communities in Florida are interested in reclaimed water ASR and are investigating the feasibility of such a system.

## Aquifer Storage and Recovery Estimated Costs

Estimated costs for an ASR system largely depend on whether the system requires pumping equipment. In **Table 75**, one system uses pressurized water from a utility, whereas the second ASR system uses unpressurized treated water, thus requiring pumping equipment as part of the system cost. The latter system with its associated pumping costs is more indicative of an ASR system in combination with surface water storage. Screening and filtering untreated surface water to remove floating and suspended matter may require additional costs.

**Table 75.** Aquifer Storage and Recovery System Costs.[a]

| System | Cost | | | | |
|---|---|---|---|---|---|
| | Well Drilling (per well) | Equipment (per well) | Engineering (per well) | Operations and Maintenance (per 1,000 gallon) | Energy (per 1,000 gallon) |
| Treated Water at System Pressure | $250,000 | $40,000 | $450,000 | $.005 | $.08 |
| Treated Water Requiring Pumping | $250,000 | $125,000 | $500,000 | $.008 | $.08 |

a. Costs based on a 900-foot, 16-inch well, with two monitoring wells using treated water; Source: *Water Supply Cost Estimates* (PBS&J, 1991), converted to 1999 dollars

## Quantity of Water Potentially Available from Aquifer Storage and Recovery

The volume of water that could be made available through ASR wells depends upon several local factors, such as well yield, water availability, variability in water supply, and variability in demand. Without additional information, it is not possible to accurately estimate the water that could be available through ASR in the LEC Planning Area. Typical storage volumes for individual wells range from 10 to 500 million gallons

(31 to 1,535 ac-ft) (Pyne, 1995). Where appropriate, multiple ASR wells could be operated as a wellfield, with the capacity determined from the recharge and/or recovery periods. All of the many applications of ASR store sufficient volumes (adequate volumes to meet the desired need) during times when water is available and recover it from the same well(s) when needed. The storage time is usually seasonal, but can also be diurnal, long-term, or for emergencies. The volume of water that could be made available by any specific user must be determined through the District's CUP program.

### Aquifer Storage and Recovery Conclusions

- The primary options are underground (ASR) and aboveground (reservoir) facilities. Both options have significant costs for capital facilities. Exact costs and yields for these systems depend on site-specific conditions.
- ASR has the advantage of providing (at least theoretically) a larger proportion of carryover storage capacity from one year to the next. They have the disadvantage of only being able to handle a limited volume of flow.
- Combined systems that use ASR for long-term storage combined with reservoirs to capture large volume flows during storm events provide maximum flexibility.

## Reservoirs

Construction of reservoirs can also be treated as either a regional water resource project or as a local water supply option, depending on the project location, scale, and population served. Regional scale applications of this technology were discussed previously. The following information provides general information that may be useful for planning efforts by local utilities.

### Definition and Discussion

This water supply option involves the capture and storage of excess surface water during rainy periods and subsequent release during drier periods for environmental and human uses. Regionally, surface water storage could be used to attenuate freshwater flows to the St. Lucie or Caloosahatchee estuaries during rainy periods and meet minimum flows during drier periods. Similar facilities could also be used in the EAA to regulate the flow of water south into the Everglades. Such facilities, on a smaller scale, could increase surface water availability for current and projected uses, and decrease the demand on aquifer and regional systems. However, evaporative and seepage losses could significantly affect water availability and need to be considered.

Strategically located surface water storage (primarily storage in combination with improved storm water management systems) could recharge SAS wellfields, reduce the potential for saltwater intrusion, and reduce drawdowns under wetlands. On-site storage in agricultural areas may reduce the need for water from the regional canal system and

withdrawals from other water source options. Storm water reservoirs could be located with ASR facilities, and provide a water source for the facility.

## Reservoir Estimated Costs

Costs associated with surface water storage vary depending on site-specific conditions of each reservoir. A site located near an existing waterway will increase the flexibility of design and management and reduce costs associated with water transmission infrastructure. Another factor related to cost would be the existing elevation of the site. Lower site elevations would allow for maximum storage for the facility while reducing costs associated with water transmission and construction excavation. Depth of the reservoir will have a large impact on the costs associated with construction. Deeper reservoirs result in higher levee elevations that can significantly increase construction costs.

Costs associated with two types of reservoirs are depicted in **Table 76**. The first is a minor facility with pumping inflow structures and levees designed to handle a maximum water depth of four feet. It also has internal levees and infrastructure to control internal flows and discharges. The second type shown below is a major facility with similar infrastructure as the minor facility. The water design depths for this facility range from 10 to 12 feet. Costs increase significantly for construction of higher levees but can be offset somewhat by the reduced land requirements.

**Table 76.** Reservoir Costs.

| | Cost ($/acre) | | | | |
|---|---|---|---|---|---|
| **Reservoir Type** | **Construction** | **Engineering/ Design** | **Construction Administration** | **Land** | **Operations and Maintenance** |
| Minor Reservoir | 2,842 | 402 | 318 | 3,000 - 6,000 | 118 |
| Major Reservoir | 7,980 | 904 | 451 | 3,000 - 6,000 | 105 |

Minor reservoir costs are based on actual construction bid estimates received and awarded for similar projects built in the EAA. Costs of these four STAs were averaged to develop the dollar per acre costs. Land costs have been changed to generally reflect land values in the Lower East Coast Planning Area ($3,000 for undeveloped/fallow land, $6,000 for land in citrus production). Major reservoir costs were developed based on the average cost estimates from the proposed Ten Mile Creek project in St. Lucie County and from the *Regional Attenuation Facility Task Force Final Report* (RAFTF, 1997) estimates for major Water Preserve Areas on the east coast.

## Quantity of Water Potentially Available from Reservoirs

Reservoirs are considered more of a management option since that these systems allow more efficient use of other sources, such as surface water. Please refer to other

source option descriptions for an estimate regarding the quantity of water that potentially could be made available.

### Reservoir Conclusions

- Storage is used to provide carryover capacity so that excess water that falls on South Florida during the rainy season can be later used to meet water demands during the dry season.
- The primary options are underground (ASR) and aboveground (reservoir) facilities. Both options have significant costs for capital facilities. Exact costs and yields for these systems depend on site-specific conditions.
- ASR has the advantage of providing (at least theoretically) a larger proportion of carryover storage capacity from one year to the next. They have the disadvantage of only being able to handle a limited volume of flow.
- Surface water reservoirs can handle larger volumes of flow, but lose water over time to seepage and evaporation.
- Combined systems that use ASR for long-term storage combined with reservoirs to capture large volume flows during storm events provide maximum flexibility.

## Surface Water

### Definition and Discussion

This water supply option involves the use of surface water as a supply source. Surface water bodies in the LEC Planning Area include lakes, rivers, and canals. Lake Okeechobee is the largest lake within the planning area, and a primary source of water supply throughout South Florida, including the direct use by local utilities surrounding the lake and as a reservoir to supply the LEC Planning Area. Surface water is also used by the City of West Palm Beach through a system of lakes and wetlands that ultimately connects to the L-8 Canal and Lake Okeechobee. Surface water from Lake Okeechobee and the WCAs can be transported via the regional canal system to provide recharge for local wellfields.

No additional potential natural sources of surface water were identified in the region that should be considered to meet future demands. The LEC Planning Area has been impacted significantly by development of land for agricultural and urban uses. This development has changed the volume and timing of surface water runoff and had negative impacts on estuarine systems. This excess runoff is being evaluated throughout the planning area to increase water availability to meet current and future needs by capturing excess surface water that would otherwise harm South Florida's coastal resources.

In the future, extensive construction of reservoirs and man-made lakes has been proposed within the region in conjunction with the Everglades Construction Project, the CERP, and the Water Preserve Areas Feasibility Study. All of these systems have some potential capability to provide water supply benefits that will be evaluated and optimized during their design and construction. In addition, opportunities may exist for local governments and private interests to create surface water impoundments or reservoirs to meet localized water needs.

### Other Potential Surface Water Sources

Another potential use for surface water systems in the LEC Planning Area is to provide supplemental sources to reclaimed water systems, when water is available, and as potential sources to capture and store (primarily through ASR) excess surface water during the wet season for use during the dry season.

Several considerations need to be addressed in evaluating surface water availability, including seasonal fluctuations, environmental needs both upstream and downstream, storage options, restoration efforts, and treatment costs. Several restoration projects are under way or proposed in the region that use natural or artificial lakes or wetlands as components of local water supply and treatment systems, or that use treated wastewater to supplement natural water flows.

### Surface Water Conclusions

- No suitable natural surface water sources for water supply development have been identified in the region.
- MFLs are being developed that will greatly affect the amount and timing of water deliveries that can be obtained from natural systems.
- In the future, regional surface water man-made lakes, impoundments, and reservoirs may be constructed. The water supply capabilities of such systems will be evaluated in the process of their design and construction.
- Construction of smaller facilities may also be appropriate to meet localized needs.
- Utilities should consider using excess surface water as a means to supplement existing reclaimed water sources and maximize reclaimed water use.

## CONCLUSIONS

The assessments presented in **Chapter 4** indicated that the proposed water resource development projects included in the alternatives, along with appropriate water supply development and operational assumptions would provide the target 1-in-10 year level of certainty. In this chapter, the water resource development projects were identified

and described. It is these projects which will be recommended in **Chapter 6**. Additional information on a large set of water supply options is also provided. Water users can select from among the permittable implementations of these options in determining their preferred water supply development actions.

## Water Resource Development Projects

**LEC Interim Plan.** The projects begun as part of the LEC Interim Plan need to be completed. In addition there are several projects which were developed based on the subregional, integrated, water supply planning processes undertaken as part of the LEC Interim Plan implementation.

**Other Federal, State, or District Projects.** The West Canal C-4 Canal Structure and the Western C-11 Water Treatment projects are critical projects which are being implemented in partnership with the federal government. Two other projects proposed in the CWMP address uncontrolled flows from abandoned wells and saltwater problems in the Caloosahatchee River. Permitting issues associated with ASR systems and reclaimed water and a specific water conservation effort, Mobile Irrigation Labs (MILs), suitable for implementation regionwide, are also included.

**CERP Projects.** These projects form the backbone of the water resource development projects included as part of the LEC Plan.

**Recommendations to the CERP Program from the LEC Plan and the CWMP.** Based on the modeling analyses performed for the LEC Plan and the CWMP, recommendations have been made regarding directions and approaches that should be included in the planning and design of CERP projects.

**Operational Strategies.** These projects will improve the water shortage policies and supply-side management to reduce the impacts of droughts on water users without compromising performance in meeting environmental goals. These recommendations are particularly important given the difficulties expected in meeting water supply performance goals until structural improvements included in this plan begin coming on-line after 2005. These difficulties are evidenced by the results of the incremental simulations (**Chapter 4**).

**Consumptive Use Permitting and Resource Protection.** These projects provide for reservations of water, develop MFLs, and specify MFL recovery and prevention strategies, as needed to meet legislative requirements and support the implementation of the LEC Plan.

**Other Projects.** These projects will provide key information to support the additional planning that will be undertaken for the update of the LEC Plan. The first project will evaluate the success of existing conservation programs, requirements, and regulations, as well as further promote implementation of conservation opportunities. The other three projects will provide key information regarding the feasibility of additional

innovative reuse systems and saltwater reverse osmosis systems and their potential role in further water resource development.

## Water Supply Development Options

Water supply development options presented in this chapter should serve as a menu that local water users can consider in determining their preferred water supply development actions. Information is provided on water supply development options that utilize conservation, SAS and FAS resources, reclaimed water, seawater desalination, storage, and surface water.